ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Vol. XXX. No. 4.

TABLE OF CONTENTS.

ENGINEERING NEWS OF THE WEEK............ 65

The Wolhaupter Brake Pressure Regulator (*illustrated*)............ 66

Railway Improvements for the World's Columbian Exposition Traffic.—VI............ 67

Water-Works Pumping Machinery at Dallas, Tex.. 67

World's Columbian Exposition—XIX.; Sewerage and Drainage............ 67

Steam Shovels and Steam Shovel Work (*continued*). 69

The Pumping Machinery at the Bridgeport Sewage Pumping Station, Chicago (*illustrated*)............ 70

European Railway Practice: Reports of the International Railway Congress............ 70

A Duplex Slide Rule............ 71

Effect of Driving Spikes (*illustrated*)............ 72

An Indian Method of Testing Lime Mortar............ 72

The Cattle Guard Problem............ 78

The Break in the Austin Dam, Texas (*illustrated*).. 78

Who Shall Judge of the Sanitary Quality of a Water Supply?............ 78

Carrying a Locomotive Across Country............ 79

Viaduct in Portland Cement Concrete, Jamaica Railway (*illustrated*)............ 79

Advance in the Design of Bridge Superstructure.... 80

Xylolith or Wood Stone............ 81

Weather Table, June............ 81

PERSONALS, NEW PUBLICATIONS, SOCIETY PROCEEDINGS............72, 73

EDITORIAL NOTES............ 74

Engineering Headquarters at the World's Columbian Exposition—Good Taste in Locomotive Design—The Boston Subway.

EDITORIAL

Public Comfort at Chicago and Philadelphia........ 74

LETTERS TO THE EDITOR............ 76

San Blas Canal Project—Electric Locomotives—Freight Traffic on Electric Railways—The New Lungstrom Planimeter (*illustrated*)—Empirical Formulas for Estimating the Cost of Pipe Sewer Work—Estimate of Cost of Railway Service—Using Levels Out of Adjustment—Responsibility for the Fire at the World's Columbian Exposition—Effect of Oils on Metals.

CONSTRUCTION NEWS............81, 84

Railways, Street Railways, Elevated and Cable Railways, Highways, Bridges, Tunnels and Canals, Water-Works, Artesian Wells, Irrigation, Sewers, Streets, Electric Light and Power, Contract Prices, Miscellaneous.

INDUSTRIAL NOTES............ 84

The claim of McArthur Bros. for "rock price" for a so-called cemented gravel, sand, etc., on the Chicago Drainage Canal, has been disallowed by Mr. Isham Randolph, Chief Engineer. The board declines to instruct its chief engineer to change his classification, and has notified the contractors to resume work within ten days under the penalty of having their contract declared abandoned and finished by the district at the cost of the contractors.

The Hudson Tunnel Co. has had a bill in chancery filed against it by Pierson & Son, of London, the late contractors, asking that a receiver be appointed to wind up the concern. The present tunnel company is the result of a consolidation of the old companies, and has $10,000,000 capital. The complainants contracted in April, 1891, to complete the tunnel, which was then 3,916 ft. long. They continued until work was suspended for want of money about one year ago, and have since kept the tunnel in repair. They claim that $45,731 is due to them. The rule to show cause is returnable before Chancellor McGill in Jersey City, on July 25.

The newly appointed permanent highway commission of Massachusetts has as its mrmbers Mr. George A. Perkins, Mr. W. E. McClintock, C. E., and Prof. N. S. Shaler. This is the first and only permanent highway commission in the country, and in its temporary form it did much good work. It will now act as a consulting board for county commissioners and advise as to location, character and cost of proposed new roads on petition from the people submitted to the county commissioners. Their purpose is to gradually reduce roadmaking to a science.

The jetties at the mouth of the Mississippi River were officially examined on July 15 as to the cause of recent shoaling and the remedy therefor. Among the guests of Maj. J. B. Quinn, Engineering Corps, U. S. A., in charge of this department, were two Louisiana Congressmen. Messrs. Poatner and Robertson. The party came back convinced that the jetties were not responsible for damming the water and causing overflow. The chief trouble seems to lie in the numerous existing outlets above the head of the Pass; these should be in great part closed, and the discharge confined to one pass. The delegation also decided that one pass was sufficient for the commercial demands of the port of New Orleans, and that any attempt to render the great Southwest Pass navigable for vessels of deep draft would be an unnecessary expenditure of public money. The present jetties will have to be extended into the Gulf, however, before long.

The north jetty, at Galveston harbor, Texas, is now 4,500 ft. long, and the sea-end is in 10½ ft. of water. The annual report of Major Miller to the Chief of Engineers shows a depth of 14¾ ft. at mean low tide on the bar, a gain of one foot in the last twelve months. This means full 16 ft. at high tide.

According to a late decision of Judge Coxe, of the U. S. Circuit Court, a device used upon the Brooklyn Bridge for lifting the cable to the grip infringes the patent issued to Daniel N. Miller. Miller is now dead, but his rights are owned by the American Cable Railway Co., who now sue. A bond of $5,000 is to be given by the Bridge Trustees until the referee decides the amount due to the owners of the patent. The device has been used at the New York end of the bridge since the bridge was opened.

A 36-in. Venturi meter made by the Builders' Iron Foundry, of Providence, R. I., is being put in position on the grounds of the World's Columbian Exposition, and will measure the entire water supply. This meter is set above ground for convenience of examination, and is provided with a new design of recording apparatus. The meter is located at the extreme southeastern corner of the grounds, between the garbage crematory and the sewage purification building. Although this part of the grounds is somewhat remote from that most frequented by visitors, there are several exhibits there of especial interest to engineers, which well repay examination.

A Nicaragua Canal bill is to be discussed at the Chicago meeting of Aug. 3 of the executive committee apointed to promote the canal project and formulate a bill for presentation to Congress as a substitute for the Sherman bill. It is in substance as follows, says the Washington "Star:" The Nicaragua Canal Co., capital stock $100,000,000, shall succeed to the rights of the Maritime Canal Co. It shall issue $4,000,000 of stock to Nicaragua, $1,500,000 to Costa Rica, and $2,000,000 to the Maritime Canal Co. in payment for concessions, and shall return to the Maritime Canal Co. what it has actually expended, with interest. There shall be fifteen directors, the President of the United States naming nine, the Maritime Canal Co. four, Nicaragua one and Costa Rica one. This act shall be void unless accepted within three months by the company, and unless within six months thereafter the work is let within the estimates of the engineers—$56,000,000. All vouchers within $10,000 are to be approved by the engineers and a member of the executive committee of the directors, and all contracts for $50,000 or more by the directory. Whenever the government pays $100,000 on canal account it shall stamp the amount of stock paid, and all stock in excess of the cost of the canal and concessions shall be canceled. To expedite the work the government shall advance $1,000,000 as soon as the contracts are let and approved.

The new Paris regulations governing the laying of electric wires by private companies forbid their location in sewers or other conduits between the curb lines. Such wires must be laid in special conduits under the sidewalks on plans approved by the municipal authorities, and to avoid crossing the streets conduits must be put on each side of the street, except on very narrow streets. Private companies cannot lay wires closer than 3¼ ft. to the front walls of buildings, that space being reserved for municipal wires. If several private companies lay wires in a street they must use a common conduit and share the expense.

The total number of failures in the United States during the six months ending June 28, 1893, excluding South Dakota, where state laws prohibit the collection of such information, is 6,239, according to statistics collected by "Bradstreet's." This is an increase of 16% over the number for the corresponding period of 1892. The total liabilities of these failures is $170,860,000, and the total assets $105,371,000, or about 62% of the liabilities. The heaviest increase in liabilities is in New York and Pennsylvania, where the increase as compared with the total indebtedness of those failing in six months of 1892, is $37,000,000, a little more than one-third of the total increase this year over last, which is $114,325,000. The relatively next heaviest increase as compared with last year, amounts to $28,000,000 in round numbers, and is accounted for by larger indebtedness in Ohio, Indiana, Michigan, Illinois and Missouri, among western states, while third in order is the increase in liabilites this year over last of $23,000,000 in four northwestern states, Wisconsin, Minnesota, Iowa and Nebraska. The larger portion of the $9,000,000 increase in southern states this year is largely accounted for in North Carolina, Tennessee, Georgia and Arkansas, while a similar increase in amount is explained on the Pacific coast by augmented totals in Californa, Oregon, Washington and Idaho.

The Kinetic Motor Co., Mr. A. P. Dodge, General Manager, has been trying its machine on the street railways of Chicago. Though little detail is given out for publication, superheated steam seems to be motive power. This is stored on the car, and a small fire of anthracite coal enables one charging of the motor to run the car 20 miles. There is no noise from exhaust steam, smoke or dust, and the company officials claim that the cost of running the motor does not exceed 2 cts. per car mile.

The most serious railway accident of the week was the derailment of a westbound express train on the Pittsburg & Western Division of the Baltimore & Ohio R. R., near Monroe Falls, O., July 25. The train consisted of ten cars drawn by two engines, and it is reported that the tender of the leading engine first left the track at a sharp curve. Five of the cars went down a 10-ft. bank. Nobody was killed, but 21 were injured, some seriously. The accident is attributed to the condition of the track. Another serious accident was the collision of a fast train with a freight car standing on the turnout of a sidetrack at Dodgeville, R. I., on the Old Colony R. R. The train was the night express from Boston to New York. The car was struck by the engine and fell against the train, crushing in the side of the mail car and tearing the side of the smoking and passenger car. A mail clerk was killed and ten persons were injured.

A cave-in. occurred July 21 in the Louisville & Nashville R. R. tunnel, near Big Stone Gap, Va. The tunnel is 600 ft. long.

A trestle near Boston, Ga., on the Savannah, Florida & Western R. R., was set on fire by incendiaries July 16, and about 180 ft. were destroyed.——The wooden trestle carrying the Intercolonial Ry. across Halifax harbor was carried away by high tides on July 23. A trestle on the St. Louis, Chicago & St. Paul R. R., near St. Louis, Mo., gave way under a freight train July 25. One man was killed and two were injured.

One of the Knowles pumping engines of the waterworks at Cleveland, O., broke down July 22, but it was hoped to get the broken part replaced within a week. The engine is of 15,000,000 capacity.

A portion of the New York water supply is to be treated by means of the same electrical process as is employed for the purification of the sewage of Brewsters, described in our issue of July 13. The water treatment plant will be located at Brewsters, and will be in the nature of an addition to the present sewage treatment plant. A 2,000-ampere current will be passed through an electrode immersed in a 3% solution of common salt and water, and the liquid thus treated will be discharged into the natural stream which conveys water from the Sodom storage reservoir to the Croton reservoir at the head of the old and new aqueducts. Two dynamos will be added to the present plant for operation in alternate 12-hour shifts, and the plant otherwise enlarged. For temporary purposes the liquid will be conveyed to the stream through 2½-in. rubber-lined hose. The hose will terminate in 40 ft. of 2½-in. pipe extending across the stream and perforated with 200 small holes through which the liquid will discharge into the stream.

At present it is proposed to treat from 30,000,000 to 40,000,000 gallons of water per day, the amount of flow being regulated at the reservoir, but the plant is designed to treat 60,000,000 gallons per day. Authority has been given to construct a plant of similar capacity below the Kensico reservoir. The Woolf Electric Disinfecting Co., 66 Broad St., New York, controls the process, and is putting in the plant.

The 3% solution of salt and water, after electrical treatment, will be used at the rate of about 10 grains per gallon of water (1 part in 5,832), which is only some 43 lbs. of salt per 1,000,000 gallons of water. Salt is said to cost only $4 per ton.

The above figures have been furnished us by Mr. Albert E. Woolf, the inventor of the process described.

Chert, properly a crypto-crystalline variety of quartz frequently occurring in nodules or concretionary layers in limestone rock, is suggested as a new paving material, and is now being investigated by Commissioner Ross, of Washington, D. C. The peculiar variety of chert recommended is found in Georgia and Alabama, and is now used to some extent in Savannah, Macon and Atlanta. It is employed apparently as a macadam material, and it is claimed that when crushed, watered and rolled it presents a hard, smooth and lasting surface, and is much cheaper than asphalt.

What is claimed to be the largest electric search light in the world has just been completed by the Schuyler Electric Co., of Middletown, Conn. The lens and mirror is 5 ft. in diameter, and the light is of 375,000,000 C. P. It is to be shipped for exhibition to the World's Fair at Chicago.

THE WOLHAUPTER BRAKE PRESSURE REGULATOR.

In our last issue we gave somewhat of an account of this device in describing the air-brake exhibits at the World's Columbian Exposition. We now illustrate it. The purpose of the device was explained last week, so far as its title is not self-explanatory. It will be enough to repeat that its special aim has been to regulate the brake pressure according to the load on the wheels in an automatic way, and with a minimum number of additional parts, all of which latter are mere massive levers and connections, little likely to get out of order and adding but little to the weight of the car.

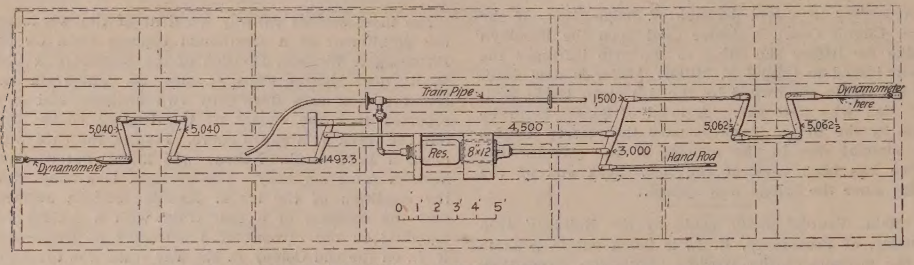


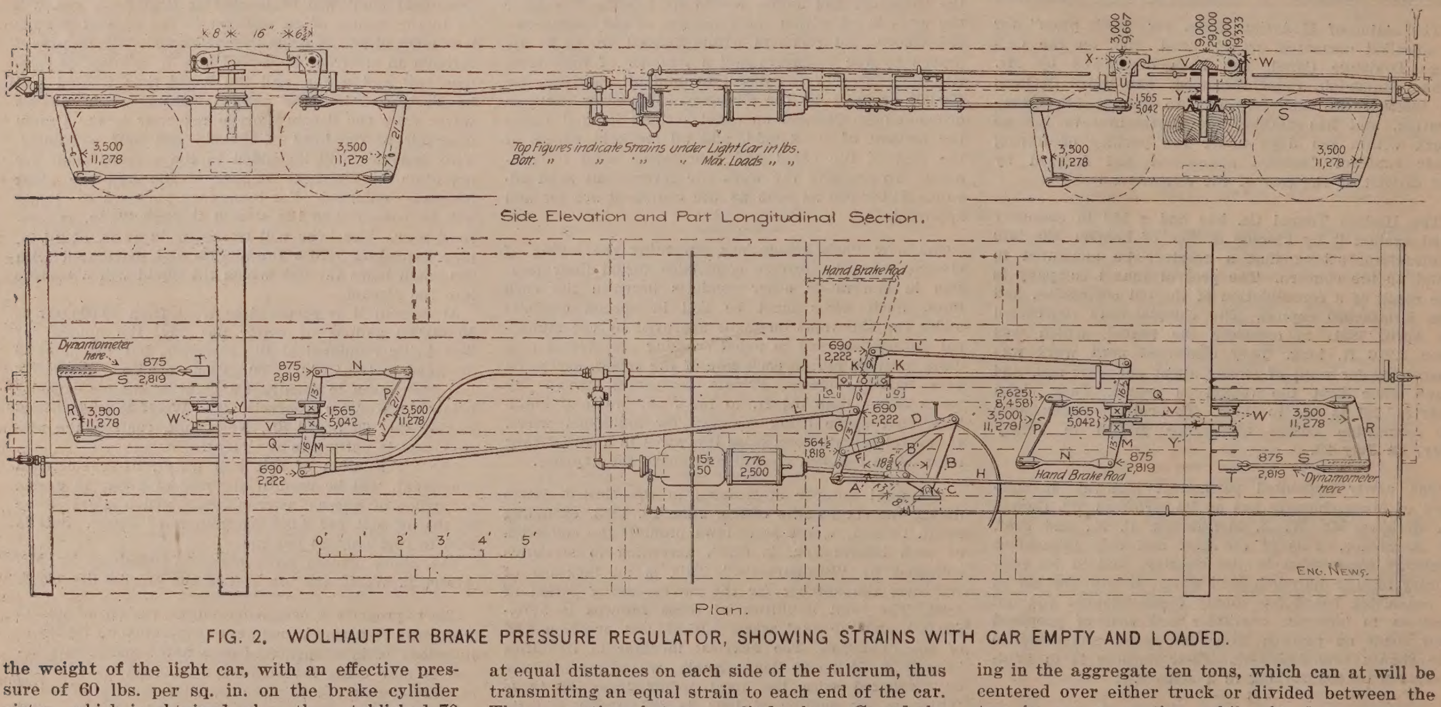
FIG. 1. FOUNDATION BRAKE RIGGING OF WISCONSIN CENTRAL RY. 40,000-LB. CAR.

Figs. 1 and 2 herewith show details of the foundation brake rigging of a box car on the Wisconsin Central Railroad, the air cylinder and reservoir being in their usual place. The box and trucks of this car weigh 28,000 lbs. and its rated capacity is 40,000 lbs. The proportions of the brake levers and also the theoretical strains to which they are air-brake cylinder at various points are shown by the figures on the cut. The brake pressures on the wheels are also given.

Fig. 3 shows the details of the hydraulic dynamometers as applied for testing purposes to the brake connections. We give this only as showing a rather simple and effective device (as it has proved) for measuring such strains, as it is not a part of the working devices.

The device is so proportioned as to respect at all times the Master Car Builders' rule—that the maximum braking pressure applied to all of the wheels of a freight car shall not exceed 70% of the weight of the light car, with an effective pressure of 60 lbs. per sq. in. on the brake cylinder piston, which is obtained when the established 70 lbs. per sq. in. is in the reservoir and trainpipe even with a minimum piston travel on an emergency stop.

The pressure and strains throughout the system are shown on Fig. 2 in two quantities at each point. The first is the strain when the car has no load in it; the second. the strain when the car has 40,000 lbs. of load. Under any of these pressures it will be seen that the pressure on the brakeshoes is less in every case than 70% of the combined weight of the trucks, the car box and the load contained therein. However, the percentage is a matter of detail, and by changing the proportioning of "weighing levers," V, on each truck may be varied as desired.



Side Elevation and Part Longitudinal Section.

Plan.

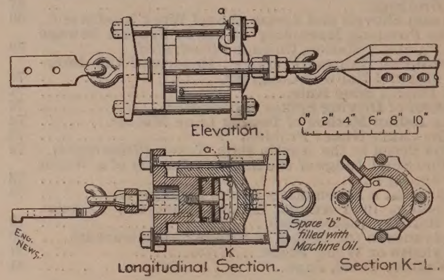
FIG. 2. WOLHAUPTER BRAKE PRESSURE REGULATOR, SHOWING STRAINS WITH CAR EMPTY AND LOADED.

The apparatus consists of two main parts. The first is the compound lever D F used to take up a relatively quick motion, so as to give a greater final pressure than heretofore without increasing the initial piston travel. By its aid the first part of the stroke of the piston gives a very rapid motion to the cylinder lever G, thus taking up the brakeshoe slack quickly. Further travel of the piston gives a much slower motion to the cylinder lever, as will be seen, and thus the braking pressure is greatly increased over that during the initial travel.

The second part of the device regulates and prevents the braking pressure on the shoes by making the brakeshoes vary according to the weight of the car-body through the car-body lifting lever V, and bent lever U, to which latter the brake levers are connected. Their effect is to make the lever M in effect a floating lever, the central force acting on it being the weight of the car-body. Of course, this necessarily requires that the brakeshoe pressure also shall vary with the weight of the car. The levers are so arranged also, as will be seen by studying the cut, that if the load is unequally distributed in the car the braking pressure on each end of the car will be proportioned to the load on that end.

The cylinder lever G is fulcrumed at K′ and the cylinder lever rods, L, L′, are connected to it at equal distances on each side of the fulcrum, thus transmitting an equal strain to each end of the car. The connections between cylinder lever G and the brake levers are shortened, and instead of carrying them from the cylinder lever to the further brake lever they are carried from the cylinder lever to an equalizing lever M (which we have just spoken of as in effect a floating lever), situated between the brake levers. The fulcrum point of the equalizing lever M is on the lower end of the bent lever U, shown most clearly in the elevation, which bears on the top of lifting lever V, whose fulcrum point is the top of the kingbolt Y. The kingbolt has a collar upon it which bears upon the lower center plate. The fulcrum point of the bent lever and the larger end of the lifting lever are supported on short gudgeons or pieces of 2-in. cold rolled shafting let into cast iron boxes, X, X and W, W, fastened to the center sills of the car. It will thus be seen that the usual floating lever rod and the floating lever with its brackets and hanger have been dispensed with and the cylinder lever rods shortened, partially compensating for the additions of the triangular lever with its links and the two equalizing levers and their lifting levers.

Referring to the triangular lever B, it will be seen that as it moves ahead the outer end to which the cylinder lever G is connected travels very much more rapidly than the end of the push rod, but that as it moves forward its speed decreases and the leverage of the push rod increases until finally the pin connection between the links, D and F, drops into the socket B′ of the triangular lever close by the push rod, after which the relative speed of the push rod and cylinder lever remains the same, the link D merely swinging around with the triangular lever B. In the movement from its initial position, as shown, until the pin connection between link D and F reaches the socket, the slack in the brakeshoes is taken up, after which the braking pressure is at its maximum.



Hydraulic Dynamometer for Testing Brake Connections.

The working of the device is admirably shown at the Columbian Exposition, where the company manufacturing it (the Brake-Pressure Regulating Co., Monadnock Building, Chicago) has a car carrying within it four little loaded trucks weighing in the aggregate ten tons, which can at will be centered over either truck or divided between the two in any proportion, while the dynamometers, shown in Fig. 3, indicate the exact brake pressures on gages adjacent to gages for the trainpipe and cylinder pressures. We have witnessed tests of the device in both emergency and service stops, and can testify that it graduated the brake pressures with great delicacy for each truck separately, according to the load on it for the time being; as indeed, it is bound to do if the levers have been computed correctly. The delicacy with which it does this also is purely a matter of mechanical detail. It would be absurd to use hardened knife-edge bearings for such a detail, as there is no object in seeking such extreme exactness, but it would be easy enough to construct the device to graduate the pressure within a pound, it being in principle as precise as any platform scale. As actually constructed, the pressure may vary 1,000 lbs. or so either way, or about 5%, but ordinarily should vary still less than that. As the device is theoretically perfect and mechanically seems strong and durable, it seems to us to promise considerable usefulness.

RAILWAY IMPROVEMENTS FOR THE WORLD'S COLUMBIAN EXPOSITION TRAFFIC.—VI.

Michigan Central R. R.—Mr. H. B. Ledyard, President, writes us that this road has added 30 new locomotives and 50 cars to its equipment. All grade crossings and drawbridges have been equipped with interlocking plant; and all open cattle guards have been filled and metal surface guards have been substituted therefor. It has largely increased its yards at Clifton, Windsor, Detroit and Kensington, and has provided track tanks on the Canada Division, on which division additonal tracks have been laid. Through trains will run between Niagara Falls and Windsor, 227 miles, without stopping. Excursion trains only will run direct to the Exposition grounds. The regular trains reaching Chicago during the day will stop at Midway Plaisance and Hyde Park, in the immediate vicinity of the Fair grounds. The road has no exhibit. The cost of improvements is given as follows: Additional equipment, $600,000; additional yards, $200,000; track tanks, interlocking plant, and cattleguard, $55,000; total, $855,000.

New York Central & Hudson River R. R.—We are indebted to Mr. E. Van Etten, General Superintendent, for the following particulars in regard to the preparations made by this road directly and indirectly for its Exposition traffic: "In regard to the track, our track is always kept in first-class condition, and no extra improvement has been made for the Exposition traffic, as we consider it in condition for fast and heavy traffic at all times. The Hudson River division, from New York to Albany, 143 miles, is all equipped with the best block system in use. We are also operating the block system on other sections of the line west of Albany, and will soon have the entire line from New York to Buffalo so equipped. This, however, was not in anticipation of the Exposition traffic particularly, but for our regular business. As to terminals, we have recently made great improvements at the station at Buffalo, and at Syracuse, and also for handling baggage at the Grand Central Station, New York, and at such other points as additional facilities were considered necessary.

"In addition to our regular train service between New York and Chicago, which is greater than any other line running out of New York, we have put on two fast trains each way, between New York and Chicago, one being the 'Exposition Flyer' (Eng. News, July 6), making the run in 19 hours, and the other the 'World's Fair Special,' making the run in 25 hours. Under the arrangement recently made by the trunk lines for running excursions to Chicago at one fare for the round trip (Eng. News, July 13), we expect to run a number of excursion trains composed exclusively of day coaches. In regard to equipment, we have added to our already large equipment, 100 coaches and 30 baggage cars for the Exposition business, and in addition, the Wagner Palace Car Co. has added to its equipment 54 new sleeping cars and 12 drawing-room cars."

Ccicago, Milwaukee & St. Paul Ry.—This road has gone carefully into the estimates of its capacity to handle passengers during the summer, and places its capacity for the 180 days of the Exposition at 2,000 per day, in addition to the regular suburban traffic and one way commercial travel. The road was double-tracked from Chicago to the Mississippi River, and from Chicago to Milwaukee by May, and is in good condition. Mr. Geo. H. Heafford, General Passenger Agent, states that in the way of equipment the number of coaches has been increased about 40%, and that of sleeping cars 25%. Many of the company's engines can be run in either freight or passenger service, and no material increase has been made in that direction. In addition to the changes in the Chicago union station, the Milwaukee station has been greatly enlarged, the capacity of its waiting-room having been doubled. Extensive preparations for handling baggage have been made at the Chicago union station, at Canal and Madison Sts., which is used by the Pennsylvania, the Chicago & Alton, the Chicago, Burlington & Quincy and the Chicago, Milwaukee & St. Paul railways. Two large baggage buildings have been constructed. The one to the south of the main station is 245 × 25 ft., and the one to the north, reaching nearly to Madison St., is 275 × 25 ft. Both are three stories high. The Chicago, Milwaukee & St. Paul Ry. will in general leave its regular trains on their present time, and will carry the additional traffic business by excursion trains. The trains from Iowa, Minnesota and Dakota will run through without stop after leaving their own territory, and some fast time will be made with them. It is proposed to shorten the time materially from the more distant divisions, and the trains will be run so as to arrive at Chicago early in the morning.

NEW WATER-WORKS PUMPING MACHINERY AT DALLAS, TEX.

By F. E. Snyder, Assistant City Engineer.

Two new pumping engines from the Holly Mfg. Co., of Lockport, N. Y., have just been accepted in this city, the official test having been completed on July 3,

Engine No. 1 is a 10,000,000-gallon cross compound low service, designed to pump from Trinity River, distant from the pumping station about 800 ft., into two storage reservoirs adjoining the station. Engine No. 2 is a 6,000,000-gallon compound high service, designed to pump from the reservoirs into the city. Engine No. 1 is to work under the following conditions: Mean low water in river, elevation, 50; reservoir flow line, elevation, 95; maximum head, about 45 ft.; to take water through about 70 ft. of 30-in. suction pipe, from a well connected with the river by a conduit and to force through about 1,200 ft. of 24-in. main into the reservoirs. This is a horizontal engine of the crank and flywheel type, operating vertical pumps through bell cranks. The pumps were set on elevation 64.5 and the engine bed carried up to elevation 94, to insure against high water in the river. The work of the engine on the test is shown by the following abstract from the engineers' report:

Summary of 10-Hour Test.

Average water pressure, shown by gage	13.8 lbs.	
Correction to be deducted	1.5 "	
Corrected gage pressure	12.3 "	= 28.41 ft. water
Average reading of vacuum gage on suction	14.84 ins. mercury	
Correction to be added	0.5 " "	
Corrected reading vacuum gage	15.34 " "	= 17.39 ft. water
Height of center water gage above valve seat		1.20 " "
Total head of resistance		47.0 ft. water

Capacity.

Total number of revolutions	11,491
Plunger displacement per revolution	408 gallons.
Water pumped, plunger displacement	4,686,328 "

(Piston speed at rated capacity not to exceed 145 ft. per minute.)

Piston speed when running at rated capacity	136.16 ft. per min.
Revolutions	17.02 per min.
Average piston speed during test	153.2 ft. per min.
Average revolutions " "	16.15 per min.
Rated capacity for 24 hours	11,251,977 gallons.
Guaranteed capacity for 24 hours	10,000,000 "
Excess (= 12.5%)	1,251,977 gallons.

Duty.

(Weight of water computed at 8.34 lbs per gallon)

Main supply of feed water, weighed	19,036 lbs.
Jacket water rated at 8% of amount weighed	1,523 "
Total	20,559 lbs.
Less 3% for saturation	617 "
Feed water consumed	19,942 lbs.

$$\text{Actual duty} = \frac{8.34 \times 4,686,328 \times 47 \times 1,000}{19.942} = 92,153,736 \text{ ft.-lbs.}$$

Duty guaranteed	80,000,000 ft.-lbs.
Excess (= 15.2%)	12,153,736 ft.-lbs.

Signed { N. Werenskiold, C. E.
R. W. Havens, C. E.

Engine No. 2 is to take water from the reservoirs through about 800 ft. of 24-in. suction pipe and deliver to the city distribution system through about 4,000 ft. of 24-in. main.

This engine is of the horizontal type throughout, being styled No. 6 Gaskill Horizontal. The water chambers are set on elevation 39 with the varying limits of suction lift between that and elevations 75 (low water in reservoirs) and 95 (flow line of reservoirs). In daily service a stand-pipe about one-quarter mile from the station is connected with the force main, the elevation of its top being 269, giving the maximum head, above water chambers, to pump against 174 ft. During the test the stand-pipe was cut off and direct pressure maintained to gain the head stipulated in the contract. This engine showed the following work as taken from the engineer's report:

Summary of 8-Hour Test.

Average water pressure shown by gage	83.24 lbs.	= 192.12 ft. water
Average reading vacuum gage		0.54 " "
Difference between center of gages		10.75 " "
Total head of resistance		203.41 ft. water

Capacity.

Total number of revolutions	9,513
Plunger displacement per revolution	212 gallons.
Water pumped, plunger displacement	2,016,756 "

(Piston speed at rated capacity not to exceed 120 ft. per minute.)

Piston speed when run at rated capacity	117.9 per min.
Revolutions when run at rated capacity	18.65 "
Average piston speed during test	118.93 ft. per min.
Average revolutions during test	19.82 per min.
Rated capacity for 24 hours at speed during test	6,050,268 gallons.
Guaranteed capacity for 24 hours	6,000,000 "
Excess (= 8%)	50,268 gallons.

Duty.

(Weight of water computed at 8.34 lbs. per gallon.)

Main supply feed water, weighed	26,474 lbs
Jacket water, 10% of above	2,647.4 "
Total consumed	29,121.4 lbs.
Less 3% for saturation	873.6 "
Feed water evaporated	28,248 lbs.

$$\text{Duty} = \frac{8.34 \times 2,016,756 \times 203.4 \times 1,000}{28,248} = 121,110,737 \text{ ft.-lbs.}$$

Duty guaranteed	105,000,000 ft.-lbs.
Excess (= 15.3%)	16,110 737 ft lbs.

Signed { N. Werenskiold, C. E.
R. W. Havens, C. E.

The test was made under the direction of N. Werenskiold, C. E., and R. W. Havens, City Engineer, for the city, and John T. Lakin, Agent, assisted by C. N. Parrot and J. C. Reamer, of the mechanical department of the Holly Mfg. Co., for the contractors.

Engine No. 1 cost $27,000 and its foundations, $5,870, a total of $32,870. Engine No. 2 cost $28,000, and its foundations, $3,200, a total of $31,200.

The city's water-works pumping plant now consists of a 10,000,000-gallon low service and two No. 6 Gaskill horizontal engines to maintain a supply of about 5,500,000 gallons daily.

WORLD'S COLUMBIAN EXPOSITION.—XIX.

Sewerage and Drainage.

Owing to the extent of the grounds and of the roof area, and to the great number of visitors to be estimated for, forming a large population, great care has been taken to provide ample sewerage and drainage facilities and to prevent any nuisance or danger to health arising from the necessary works. The general plans adopted were described in our issues of Jan. 16 and March 26, 1892, and still further in our issue of March 23, 1893, in which latter issue the Shone pneumatic system of forcing the sewage to the purification works was described. We give below a well written paper on "The Sewerage of the World's Columbian Exposition," by C. B. McClure and F. M. Spalding, which we reprint in part from the "Technograph" (University of Illinois), omitting only the description of the Shone system, which we have already published, and the description of the sewage purification plant, which we shall give very fully in our next issue. The authors express their obligation to Mr. F. H. Eno, Assistant Engineer in the Water Supply and Sewerage Department of the Exposition, for information furnished:

The World's Columbian Exposition has complete systems of water-works and sewerage sufficient in capacity for a city of 400,000 inhabitants. Owing to the flatness of the site and to the cost of construction of a combined system of sewers, the sewerage is divided into three distinct systems: 1. Roof drains. 2. Storm water sewers. 3. Sanitary or ejector sewers. The different systems will be described in order.

Roof Drains.—The roof drains, carrying the water from the roofs, have their outlet in the nearest waterway. In designing the size and grade of these sewers, the maximum rate of rainfall was taken at 1 in. per hour, all of which was considered to reach the sewer. The amount of the waterway provided is probably not sufficient for heavy storms, and the sewers at such times will necessarily flow under a head, because the assumed rate of rainfall is often doubled and sometimes trebled in short, sharp storms. In a permanent system this might prove a serious difficulty, but for the few heavy storms likely to occur during the continuance of the Exposition there will probably be no trouble.

On the Mines and Mining Building there are 62 down spouts. The roof area of this building is 225,000 sq. ft., making a down spout for every 3,630 sq. ft. The Manufactures and Liberal Arts Building has 224 down spouts, or one for every 5,930 sq. ft. of roof area. Down spouts are made of 6-in. galvanized iron. Connection is made with the sewer by a 6 in. vitrified pipe leading directly from the bottom of down spout to the sewer. The total number of manholes in the roof drain system is 49. The following table gives the total amount of vitrified sewer pipe used in the construction of roof drains:

Diameter.	Length.	Diameter.	Length.
6-in.	30,09 ft.	12-in.	5,684 ft.
8 "	7,259 "	15 "	5,052 "
9 "	3, 61 "	18 "	2,181 "
10 "	4,159 "	.....	.....

Storm Water Sewers.—The storm water sewers carry all water falling on the pavements, sidewalks and grass swards. It is very desirable to keep the water in lagoon, canals, and basin free from filth and dirt of all kinds, and as the storm water sewers will carry a large quantity of paper, rags, peanut shells etc., all pavement sewers discharge into the lake. From this drainage the grounds are divided into three districts: 1st, that draining the larger portion of the grounds, including the area south of Fifty-ninth St. and west and south of the lagoon and basin, and having its outlet in the southern part of the grounds just north of the Forestry Building; 2d, that draining the area around the Manufactures Building and Government Building, and having its outlet east of the Government Building; 3d, all that portion of the grounds lying north of Fifty-ninth St. and having its outlet at the head of Fifty-Seventh St. The maximum rate of rainfall was taken at 1 in. per hour over the area drained, excluding the buildings, and it was assumed that all this rainfall reached the sewer. Kutter's formula, with $n = 0.013$, was used in the computations, and 2 ft. per sec. was the minimum velocity allowed. This gives approximately the following minimum grades: 6-in. pipe, 1 in 450; 8-in. pipe, 1 in 250; 12-in. pipe, 1 in 450; 18-in. pipe, 1 in 850. At the time of this assumed flow the storm water sewers will flow under a head of 2 to 6 ft., but it is not probable that they will often be so heavily taxed.

The sewers consist of salt-glazed vitrified sewer pipe, brick sewers and box drains. Vitrified sewer pipe is used for lines varying from 6 to 18 ins. diameter. Brick sewers are used for lines varying from 18 to 36 ins. diameter. Above 36 ins. box drains are used. The pipe used was first-class vitrified sewer pipe. Where excessive quicksand and water were encountered, deep-socket pipe was used, the joints being calked with oakum before cementing. Deep-socket pipes have a bell 3 ins. deep, and the spigot and inside of bell are grooved or roughened to hold the oakum in place. The brick sewers are made of single or double rows of brick, according to the amount of water and quicksand encountered and to the depth of sewer below the surface.

The top and sides of the box drain are constructed of pine, while the bottom is concrete. The sides consist of 3 × 9-in. tongued and grooved sheeting 9 ft. long driven to the proper grade. Two inches from the top on the inner side of the sheeting 4 × 4-in. stringers were attached, and 4 × 6-in. cross girders were laid on these stringers 2 ft. apart. The girders were notched 4 ins. to make them flush with the sheeting. The top is made of 2 × 6-in. matched plank securely nailed to the cross girders. The bottom is of concrete 1 ft. thick. The concrete consists of one part mortar to three parts broken stone, and the mortar of one part Portland cement to three parts of sand, both by measure. The radius of curvature of the bottom varies with the width of the sewer from 3.5 to 5.5 ft. The width of sewer varies from 3 to 5.5 ft. The depth at center varies from 3 ft. 6 ins. to 3 ft. 9 ins. The box drains were used on account of cheapness and ease of construction, and are well adapted to the temporary work for which they are designed.

Manholes on the pipe and brick sewers were put in 250 to 300 ft. apart on the straight lines, and also at every change of direction of sewer. Manholes were built of brick, the walls being 8 ins. thick laid in mortar, and were finished at pavement grade with a cast iron suburban manhole cover, somewhat lighter than that used in the business portion of the city. The total number of manholes on the pavement sewers is 316. Catchbasins are usually placed in pairs one on either side of the roadway, the distance between pairs varying from 150 to 300 ft. The catchbasins are made of a 3-ft. section of 18-in. vitrified sewer pipe with an 8-in. spur molded on at an angle of 34°. Pipes are set on a bed of concrete 6 ins. thick and are finished on the inside with a coat of neat cement mortar, troweled smooth. Catchbasins are finished at pavement grade with a cast iron grated cover. The cover is set in cement mortar. The connections with the sewer are made with curved and straight pipe. The total number of catchbasins of sewer pipe is 473, and in addition there are 50 brick catchbasins.

In order not to spoil the appearance of the interior waterways and the lake shore all outlet pipes are required to be 1.5 ft. below datum. Datum is taken as the average level of Lake Michigan for several years, according to the records of the city of Chicago. The elevation of the surface of the ground varies from 5 to 11 ft. above datum (Eng. News, March 5, 1892), and the depth of sewers below the surface varies from 3.5 to 12 ft. The average cut was about 5.5 ft. The ground was excavated in open trenches to the necessary depth, with a width 2 ft. wider than the exterior diameter of the sewer. The work was carefully backfilled, the earth being rammed under and around the pipe, the remainder of the trench being filled without ramming. Pipe were laid in bottoms of 25 ft. under a line in perfect conformity with lines and levels given. The contractor furnished all pipe specials, cement, yarn, etc., and did all excavating and back-filling. Nearly all the ground was sandy; some gravelly quicksand, necessitating the use of sheeting, was met at all points below 1 ft. above datum. The following tables give the total length of sewers constructed and the price per lin. ft.:

Vitrified Pipe Sewers.

Diameter, ins.	Ordinary socket. Length, ft.	Ordinary socket. Price per lin. ft.	Deep socket. Length, ft.	Deep socket. Price per lin. ft.
4	6,354	......	......	......
5	1,056	......	......	......
6	32,021	$0.275	412	$0.29
8	40,668	0.315	5,4 1	0.36
9	1,614	0.40	496	0.50
10	7,910	0.53	1,584	0.63
12	8,594	0.65	2,980	0.72
15	3,430	0.80	3,284	0.90
18	4,992	0.98	523	1 08
Total....	106,639	... ..	14, 30	......

Brick Sewers and Box Drains.

Diameter, ins.	Total length. Double ring brick sewer, ft.	Total length. Box drains.	Price per lin. ft.
21	570	......	$1.48
22	588	......	1.55
24	2,211	......	1.62
27	730	......	1.80
28	550	......	1.84
34	289	......	2.25
36	2,105	......	2 65
33	......	5,690	2.85
66	......	2,072	5 15
Total.........	7,043	7,762	....

Manholes cost $15 apiece and catchbasins $11.20. The total length of pavement sewers is 26.1 miles, and the total cost of this system is approximately $98,860.

Sanitary Sewers.—The third and most important system is the ejector or sanitary system of sewers for the removal of sewage proper. There are 16 buildings provided for the purposes of the Exhibition, which vary in size of area from 1 to 30.5 acres. Besides these there are 40 or more smaller buildings built by the different states and by foreign countries. There are in all 150 acres of buildings for which sanitary sewers must be provided. A daily attendance of 150,000, with a probable maximum of 400,000, was anticipated. For the accommodation and convenience of this multitude there are numerous toilet rooms and lavatories, with a total of 3,500 water closets and 1,000 urinals, and with wash basins in proportion. The maximum attendance of 400,000 was estimated to occur between the hours of 7 a. m. and 11 p. m., during 16 hours of a day; in other words, this would be a rate of attendance of 600,000 people per 24 hours. As the maximum quantity of sewage expected is 8,500,000 gallons, which is the capacity of the disposal works, the maximum quantity of sewage per capita expected is then 14 gallons per 24 hours.*

Any system of collection of sewage by gravitation sewers alone would necessitate very light grades, owing to the flatness of the site, it varying from 5 ft. to 11 ft. above Lake Michigan. If the combined system were used, the sewers would necessarily be large and expensive. It was, therefore, decided to put in a separate system of sewers for the removal of the sewage proper and to pump the sewage to the purification works in the southeast part of the grounds. The Shone system was adopted to do this work. (Eng. News, March 23, 1893.) The ejectors are placed in pairs in stations so constructed that the sewers will flow by gravity into the ejectors. The air chamber of the ejectors is 2 ft. high and 10 ins. diameter.

There are 26 ejector stations located over the grounds, the majority being beneath the buildings, some under the grass plots and some under the roadways. These stations consist of a wooden or brick pit, in which are two ejectors, one ejector being held in reserve and used only in case of emergency. When the stations are inside the buildings the pit is built of 4 × 6-in. matched sheeting, and is 10 to 11 ft. deep and 11.5 ft. diameter, with 2 ft. of concrete in the bottom. The pits are designed to be watertight. When the stations are outside the buildings the pits are constructed with 12-in. brick walls and have 18 ins. of concrete in the bottom. The depth of the pit is 11 ft and the width is 11.5 ft.; the top is covered with two layers of 6 × 6-in. timbers laid crosswise. The capacity of the ejectors varies from 60 to 600 gallons per minute, and their united capacity is 11,400 gallons per minute, or 17,000,000 gallons per 24 hours. In other words, both ejectors in each pit will have to discharge once a minute. There are 3 miles of gravitation collecting sewers running into the ejectors. These sewers are either 6 or 8-in. deep-socket vitrified pipe, except when laid inside the buildings, when wrought iron pipe is used. The minimum grade for the 6-in. is 1 in 150, and for the 8-in. 1 in 250.

The air-compressing plant for operating the ejectors is situated in Machinery Hall. There are 5 miles of air pipe leading from this plant to the different ejector stations, varying in diameter from 2 to 10 ins. Those laid under buildings and those less than 4 ins. diameter are wrought iron screw pipe; all the remaining pipes are cast iron. The average depth of covering is 4.5 ft. The line was tested to stand 90 lbs. pressure per sq. in. without loss. From the ejectors there are 4.8 miles of cast iron discharge pipe leading to the sewage disposal works. The size of pipe varies from 6 to 30 ins. The maximum lift from the discharging level of the lowest ejector to the top of the precipitating tank is 67.6 ft., and the total head to be pumped against when the maximum estimated amount of sewage is being discharged is 107.8 ft. A pressure of 47 lbs. per sq. in. will be maintained in the air mains, and each ejector will be provided with reducing valves, so that just the necessary pressure will be used.

The contractor was paid a certain price per foot for the pipe laid. Profiles were furnished of the pipe lines, and when the pipes were for any reason laid deeper, an extra allowance was made for the deeper cut. All specials and stop gates were put in as required by the engineer. The pipe was all furnished by the exposition management. The contractor furnished lead, yarn, etc., and $20 per 1,000 ft. B. M. was allowed for timber left in the trench by order of the engineer. The cost of pipelaying is given in the accompanying table:

Cost of pipe laying.

Material.	Diam.	Cost per ft.	Material.	Diam.	Cost per ft.
Wrought iron.	2 in.	$0.08	Cast iron......	12 in.	$0 27
" "	3 "	0 09	" "	14 "	0.43
" "	4 "	0.10	" "	16 "	0.45
Cast iron......	4 "	0.13	" "	20 "	0.60
" "	6 "	0.17	" "	24 "	0.65
" "	8 "	0.20	" "	30 "	0 85
" "	10 "	0.22	" "	36 "	0.60

The cost of the entire ejector system was as follows:

Discharge pipes: a. Cast iron pipe and valves.	$15 000
b. Wrought iron pipe....	20,000
c. Laying...........	15,000
Vitrified sewers....	8,000
Wrought iron feed sewers...........	20,000
Ejector pits....	13,000
Ejectors...	67,000
Total cost	$188 000

These figures are approximate; roughly, $200,000 was expended on the sanitary sewers.

Officers of Bureau of Construction.

The following is a list of engineers and officers in the Bureau of Construction, at the head of which Bureau is Mr. D. H. Burnham, Director of Works. The offices of this Bureau are in the Service Building, near the Sixty-second St. entrance to the grounds:

Director of Works; D. H. Burnham.
Assistant Director of Works; E. R. Graham.
Secretary of Works; M. B. Pickett.
Chief Engineer; E. C. Shankland.
Engineer of Water Supply and Sewerage; Wm. S. McHarg.
Assist. Eng. of Water Department; C. M. Wilkes.
Engineer of Grades and Surveys; J. W. Alvord.
Assist. Eng. of Grades and Surveys; J. H. Binkley.
Mechanical Engineer; C. F. Foster.
Electrical Engineer; R. H. Pierce.
Chief Draftsman; F. O. Cloyes.
Purchasing Agent; F. J. Mulcahy.
Gen. Man. of Transportation; W. H. Holcomb.
Assist. Gen Man. of Transportation; E. G. Nourse.
Landscape Architects; Olmsted, Olmsted & Eliot.
Superintendent of Landscape; R. Ulrich.

---

*With the present total attendance of 125,000 to 150,000 per day, the total sewage flow is about 2 000 000 gallons. The maximum capacity of the works when giving the sewage through purification is about 3,000,000 gallons per 24 hours.—Ed.

Designer-in-Chief; Charles B. Atwood.
Director of Decoration; F. D. Millet.
Assistant Director of Decoration; C. Y. Turner.
Superintendent Art Building; C. Y. Turner.
Superintendent of Painting; E. D. Allen.
Gen. Supt. of Buildings; W. D. Richardson.
Supt. of Interior Docking; D. A. Collins.
Superintendent of Plumbing; E. R. Loring.
Supt. of Midway Plaisance; A. A. Clark.
Supt. of Elevated Railway; J. Worcester.
Building Superintendents; W. E. Brown, B. B. Cheeseman, J. K. Freitag, H. S. Hibbard, C. A. Jordan, J. H. Murphy, A. C. Speed, F. W. Watts, M. Young.
Fire Marshal (14th Battalion, Chicago Fire Department); Edward W. Murphy.
Medical Director; John E. Owens.

STEAM SHOVELS AND STEAM SHOVEL WORK.*

By E. A. Hermann, M. Am. Soc. C. E.

Part II.—Steam Shovel Work.

(Continued from page 47.)

The machine shown in Fig. 92 has lately come into use for pulling the plow over the cars to unload them. This is merely a double cylinder (10 × 12 ins.) reversible hoisting engine, resting on a heavy cast iron bedplate attached to the floor of a box car. Steam is supplied to the engine from the locomotive of the train, which is coupled to this car when the unloading is to begin. With this machine there is no injurious jerking of the cable, and consequently very little breakages or delays, and heavy loads of 15 cu. yds. of tenacious material are readily plowed off the cars in a more satisfactory manner than can be done by any one or two locomotives. Blocking the wheels or chaining cars to the track need not be resorted to; the cars cannot move, for the machine pulls the plow toward itself and the strain is resisted by the cars between them. If it is desired to scatter small quantities of material along the track, as it is often wanted in surfacing or raising track, both plow and train are moved in the same direction at the same or varying speeds, as may be necessary to unload the required amount of material. If a large quantity of material is wanted within a short distance, as usually happens on washouts, train and plow are moved in opposite directions. By moving them in this manner at the same speed, a whole train can be unloaded at any desired spot. Where two locomotives must be used to pull the plow over the cars, the use of this machine will dispense with one of them, and do the work in half the time. On large jobs it should not be missing. The cable is wound around the drum, A, Fig. 92, and must be long enough to extend over the whole length of the train. A steel wire cable 1⅛ ins. diameter is generally used; but for loose gravel a 1-in. cable is amply strong enough.

The steam shovel can be operated continuously throughout the year in all kinds of weather, though operations are often suspended in extremely cold weather. When working in cold weather the face of the bank sometimes freezes during the night to the depth of 3 to 6 ins., but this crust is easily broken in the morning by a few small charges of powder, and then the material can be excavated as easily as at any other season.

In freezing weather the floors of the cars should be sprinkled with brine just before loading; the brine is kept in barrels at the head of the machine, and one man using an ordinary garden sprinkling can is detailed for the work. This prevents the material from freezing to the floor of the car for three to four hours, and allows it to slip off readily when the plow is put in operation. No train should be left standing over night without unloading. The brine will not prevent freezing for this length of time, and to unload one car of the frozen stuff requires a day's labor of four to six men.

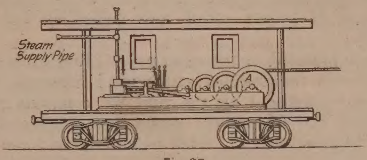


Fig. 92.

Distributing the Material After Unloading.—In widening embankments for side tracks, double track, yard and station grounds, etc., the material is unloaded, as described above, forming a ridge on both sides of the track if unloaded with the center plow, or on one side of the track only if unloaded with the side plow. This material is sometimes leveled off by hand, a very slow and expensive job, but generally it is done with a leveler or spreader, Figs. 93 to 96.

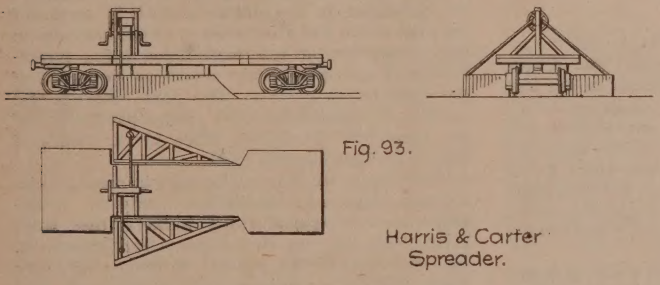


Fig. 93.

Harris & Carter Spreader.

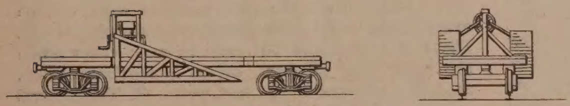


Fig. 94.

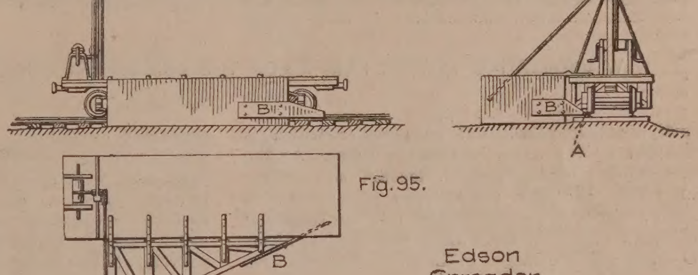


Fig. 95.

Edson Spreader.

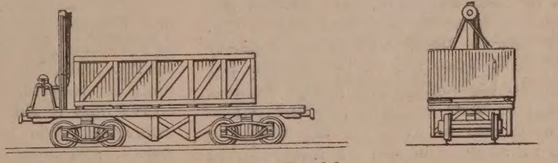


Fig. 96.

In the Harris & Carter spreader, Figs. 93 and 94, the car body is cut away between the trucks to receive the two wings which level or spread the material. One or both wings can be used, and they can be raised and lowered to adjust them to any height of new embankment wanted. They will spread the material for a distance of 3 ft. from the rail. When shipping the spreader over the road the wings are drawn up by a hand windlass, revolving about hinges fixed to the braces under the floor of the car, as shown in Fig. 94. In this position the clearance is the same as that of an ordinary passenger car.

The Edson spreader, Figs. 95 and 96, has only one wing, attached to an ordinary flat car, and arranged to raise and lower to adjust it to any height of new embankment wanted. The wheel, A, bears against the head of the rail, forming a brace where one is most needed, and greatly assists in preventing a derailment when hard or tenacious materials are suddenly encountered. The wing, braces, windlass, etc., are so constructed that they can be readily removed from the car, thereby restoring it to general service on completion of the work in hand. This spreader is used mostly in connection with the side plow; it will level the material for a distance of 15 ft. from the rail, wide enough to permit laying a side track from which the embankment can be further widened. Only one side at a time can be widened with this spreader. If it is desired to widen the embankment on both sides of the track, one side is completed first; the cars and spreader are then turned around on the nearest turntable or Y-track, and the other side widened by drawing the spreader in the opposite direction. If the cars are not provided with aprons they need not be turned around. This spreader is generally arranged to cut about 6 ins. below the bottom of the ties of the main track, thereby forming the subgrade for the sidetrack, and maintaining proper drainage of the main track. The apron, B, is bolted on the spreader, and serves to remove any loose material which may fall on the track between the rail and the ends of the ties. When shipping the spreader over the road, Fig. 96, it is drawn up by a hand windlass revolving about hinges on the side sill of the car and folded down on it; in this position it will clear anything that other cars can pass.

The cars of both styles of spreaders are loaded with old rails, frogs, scrapiron, etc., to hold them down and prevent derailments when hard or tenacious materials are suddenly encountered. Loads of five to ten tons are generally sufficient, though loads up to 15 tons are sometimes required.

Spreaders are usually drawn at a speed of six to eight miles per hour; in loose gravel the speed often reaches ten miles per hour. They will level off a ridge a mile in length in six to ten minutes, doing as much work in that time as 100 men can do in a day.

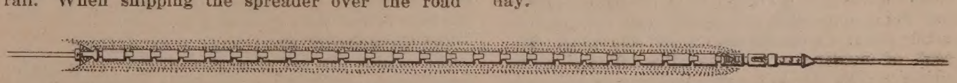


Fig. 97.

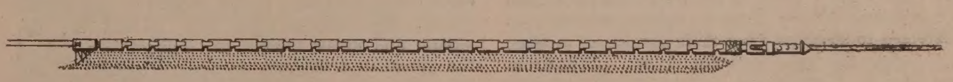


Fig. 98.

The spreader is usually stationed in the nearest sidetrack to the unloading place. Frequently it can be hauled between this track and the dump without raising it, or raising it only partially to clear depot platforms, switch stands and other obstructions and thereby avoid the necessity of folding it down on the car while passing between these points.

Ordinarily the spreading is done by the last train before the close of the day. In cold weather or on short dumps it must be done oftener; either to prevent freezing, or to make room for the unloading material which would otherwise pile up too high for easy spreading, or be liable to roll back on the track and obstruct it for the next train. In using the spreader it is coupled to the rear of the car carrying the plow, and after the train has been unloaded it is pulled over the length of the ridge of material unloaded from its own and preceding trains, as shown in Figs. 97 and 98.

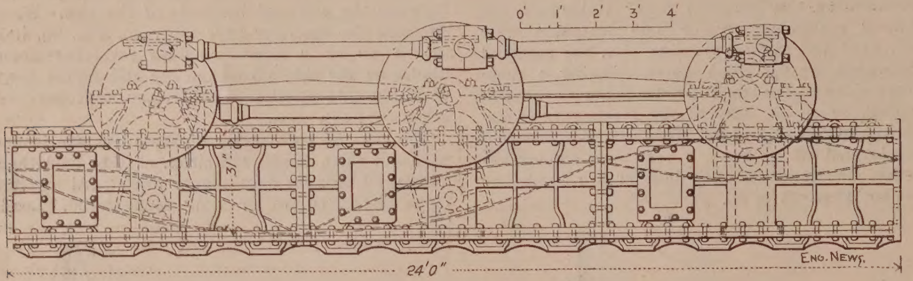
---

*Copyright, 1893.

(To be continued.)

PUMPING MACHINERY TESTS AT THE BRIDGEPORT SEWAGE PUMPING STATION, CHICAGO.

A test of a new type of low-lift pump, built by the Courtright Hydraulic Mfg. Co., 415 Rookery Building, Chicago, was made at the Bridgeport pumping station, on July 18 and 19, by the Robert W. Hunt Co. Testing and Inspection Bureau. The test was carried out under the direction of Prof. R. C. Carpenter, of Cornell University.



NEW UNDULATING SEWAGE PUMPS FOR THE BRIDGEPORT CANAL STATION, CHICAGO.

As most of our readers know, the Bridgeport pumping station is practically the sole reliance for purifying that pestilential open sewer which is dignified by the name of Chicago River. At the Bridgeport pumping station, located some three miles from the lake, the Chicago River water is lifted about 6 ft. and discharged into the Illinois & Michigan canal. It flows along this channel about 30 miles and discharges at Lockport into the Des Plaines River.

The machinery which has been in use for some years, at Bridgeport, consists of four slow-speed vertical compound engines built by the Quintard Iron Works, of New York city, each driving two centrifugal pumps built by Jos. Edwards & Co., of New York City, in 1884. The utmost capacity of this plant was 60,000 cu. ft. per minute, but this was with all the engines and pumps working up to the limit of their capacity. Neither pumps or engines were able to work for the whole 24 hours, week in and week out, at this rate, in fact, allowing proper time for cleaning, oiling, adjusting and ordinary repairs, it is doubtful whether the average daily output can be maintained at over two-thirds the full capacity of the plant.

The flowing capacity of the Illinois & Michigan Canal may be taken for the purposes of this discussion at 60,000 cu. ft. per minute. In fact, 50,000 cu. ft. is as much as can be carried and still leave sufficient headway for boats on the canal to pass under the bridges. It is vitally important that the pumps should maintain the rate of flow in the canal at its maximum, all the time. The result of stopping or lessening the delivery of the pumps is well shown by the condition of the river at the present time, after the partial stoppage of the pumps for a week or so, while the tests were being prepared for and made. Chicagoans are accustomed to stenches from their putrescent stream, but during the past fortnight or so its condition has been so much worse as to seriously interfere with business along it. We may discuss this matter more fully in a later issue. At present we merely desire to explain the reasons which justified the city's engineers in their attempt to increase the capacity of the Bridgeport pumps to 100,000 cu. ft. per minute, thus providing a margin sufficient to maintain at all times the maximum flow in the canal.

The contract made with the Courtright Co. provided for the replacement of the four pairs of centrifugal pumps (whose maximum capacity was some 16,000 cu. ft. per minute per pair) with four pairs of Courtright undulatory pumps, a machine which has never before been tested in service. Each pair of Courtright pumps was to have a capacity of 25,000 cu. ft. per minute with the engine running at 100 revolutions, and the acceptance of the last three pairs was conditioned on the first pair proving satisfactory. It was this first pair of pumps which was tested on July 18 and 19.

It was planned to run each pair of the Courtright pumps with the engines which were formerly used for the centrifugal pumps, and we conclude from this that the Courtright pump was expected to give a high efficiency. Each pair of the old centrifugal pumps, we understand, threw about 16,000 cu. ft. per minute when absorbing the full power of the engine and had a mechanical efficiency of about 50%. To throw 25,000 cu. ft. with the same engine power, therefore, the Courtright pumps would have had to work with over 78% efficiency. The contract, however, made no requirement regarding efficiency, and the result of the test was probably a surprise in this respect to both engineers and contractors. It was found that the engine could not reach the prescribed 100 revolutions even with the aid of live steam in the low-pressure cylinder. In fact, we understand that some 40 revolutions was about the highest rate which could be maintained, and at this speed the delivery of the Courtright pumps was under 10,000 cu. ft. per minute. After running the Courtright pumps for six hours at as high a speed as could be attained, one of the connecting rod ends broke, and the test was discontinued.

The accompanying drawing shows a side elevation of one of the Courtright pumps. It consists merely of a rectangular box 24 ft. long, 31 ins. deep and 51 ins. wide. In this are three undulating "pistons," or rockers, the shape of which is shown by dotted lines in the drawings. These are driven by connecting rods from a central gear wheel, as shown, and they have a combined vertical and oscillating motion, so timed that something like a progressive undulation goes on from one end of the chamber to the other. The points of the rockers are not connected, but their motion is such that they keep close to each other, no matter what their position, with not more than ½ in. clearance between them. At the sides and bottom the clearance between the rockers and the walls of the chamber is about 3-16 in., and the effect of this large clearance in reducing the efficiency of the machine is doubtless considerable.

The operation of the pumps is as follows:

The cranks are set at angles of 120° with each other and are pivotally connected with their respective pitmans, thus causing an oscillating reciprocating movement in the rockers as the cranks rotate. The cranks turn over toward the upstream and under toward the downstream end of the pump, and the rockers always present an obstructing angle toward the incoming water. The upstream end of the rocker is always horizontally in advance of its vertical travel. The water alternates in its passage through the pump from the upper to the lower side of the rockers. A more serious defect in the Courtright machine for sewage pumping work than its lack of capacity or duty is the liability to breakage by sticks or other obstructions. As stated above, when the lenticular pistons or rockers oscillate they leave 3-16 in. clearance between their surfaces and the top and bottom walls of the chamber. This clearance is so small that a stick or other obstruction of moderate size might readily be caught under the point of one of the pistons, where its leverage, tending to strain the crank arm by which the piston is driven, would be very great.

It may be thought that the sewage might be screened before passing to the pumps; and as a matter of fact a screen is in position, otherwise it would not be possible to run even the centrifugal pumps. But the amount of floating and solid matter in the Chicago River is such that a screen with 3-16-in. openings would be quite impracticable, and the screen which is in position requires a great amount of labor to keep clear. An engineer who is familiar with the station informs us that the obstruction of the present screen to the flow is such that the water often stands 3 to 6 ins. higher one side than on the other.

In a later issue we hope to give our readers the official results of the test, which are of especial interest as they involve unusually large quantities of water handled under a very low head, and the measurement of the flow over a weir of very great width.

EUROPEAN RAILWAY PRACTICE; REPORTS OF THE INTERNATIONAL RAILWAY CONGRESS.

The International Railway Congress is an association of representatives of the railways in all parts of the world, with Europe in the majority and the United States in a conspicuous minority. Its headquarters are in Belgium, and its meetings are held every three years for the discussion of questions relating to various departments of railway science. We give below some particulars of the reports presented and discussed at the fourth congress, which was held at St. Petersburg, Russia, in August and September, 1892, which particulars we have abstracted from the official report of the congress. The method of procedure is to assign certain subjects to certain members, whose reports on papers are published in the official periodical organ of the association and are discussed at the meetings, a final conclusion or recommendation being formulated and appended to the report as the sense of the congress as a body. The next congress will be held in London in 1895. Some particulars of the association have been given in our issues of March 26 and May 26, 1892.

Maintenance of Way.—The rules in regard to inspection should be modified as follows: 1. The suppression of special track walkers, that work being intrusted to the regular sectionmen. 2. The reduction of the number of rounds made by track walkers, sometimes even to one each day. The first trip should be made in the morning, either at the time when the gang goes to work, or, on some roads, before the passage of the first train. The last trip should be made in most cases when the gang goes off duty, or, in exceptional cases, after the passage of the last train. 3. The general suppression of night inspection. 4. The suppression of special inspection of the tightness of keys on track laid with double-head rails in chairs. There is observable a general tendency to adopt an average number of four to six men to a gang, or one man per kilometer (0.62 mile) of double track with heavy traffic. This is reduced with less traffic and lighter engines, and on some lines with light traffic there is one man to three kilometers (1.82 miles). In certain cases the gangs are reduced to less than four men, even to a track man working alone. The number of men varies, of course, according to circumstances, and especially with the profile of the line, character of ballast and track, speed of trains, weight of engines, climate and condition of subgrade. The two systems of maintenance by periodical renewals and by continual repair and renewal both give safety for the operation of traffic, but the former, which has only been in use systematically for a few years, is being adopted by several European railways.

Relations Between Track and Rolling Stock.—For high speeds and heavy wheel loads an increase of stability of the rail is necessary, and may be secured by increasing the width of base of the rail or by using tieplates or chairs. The rail head was recommended to be as wide as possible, with a top of large radius, sides conforming to the profile of the wheel tires (which is a very grave mistake), as mall fishing angle, and as large a bearing surface as possible for the splice bars. The height of head and thickness of web and flange should be proportioned for good rolling of the metal. The increase of length of rails effects an improvement by reducing the number of joints, but as it involves an increased space at the joints the latter must be correspondingly strengthened. There is a tendency toward the use of tieplates or chairs on wooden ties. It was urgently recommended that new investigations and tests should be made in regard to rail joints, their wear, the strain upon them, and the merits of new patterns. This subject is to be considered at the next congress, in 1895.

Relations Between Bridges and Rolling Stock.—The track and bridges on main international lines should be designed for a load of two vehicles having each four axles 4 ft. c. to c., with a load of 14 tons per axle. A uniform international system of tests of material of construction was recommended, and thanks were tendered to the French government for the preliminary investigations which it has undertaken for this purpose. The matter is to be discussed at the next congress, and meanwhile the following information is to be collected as to practice by different railways in various countries: 1. Loads used in calculations for bridge design; 2, Methods of calculation; 3, Coefficients of safety; 4, Formulas for estimating the weight of metal floor systems; 5, Methods of strengthening bridges to adapt them for heavier loads.

Track for Fast Trains.—Sharp curves should be eliminated as far as possible, and strict rules enforced for slackening speed at such curves. The question of the effects of curves and grades on fast trains is to be considered at the next congress.

Breakage and Wear of Rails.—In view of the general tendency to increase the weight of rails, and the improvements in rail manufacture, it was considered best to continue the investigations and to have a report made at the next congress.

Maintenance of Track with Metal Ties.—Experience of several years on roads under varying conditions has proved that when suitable ties are properly laid a decided economy in labor may be effected. The investigations on this subject are being continued.

Rolling Stock and Track on Curves.—By proper limitation of speed the curves may be reduced to 150 meters (11°) or even less, exceptionally, for ordinary rolling stock on standard gage lines without heavy traffic. The increase of resistance due to curves on level track is estimated from tests that have been carried out at 8.8 lbs. per ton for curves of 656 ft. radius (9°) and 13.2 lbs. for curves of 11.7°, these figures being given as indications only, and varying within very wide limits. These figures enter into consideration in the location of new lines, and the report states that sharp curves involve an increase in cost of operation, not only by the increased resistance, but by the wear of rails and ties, while the liability to deformation of track and alinement, due to curve resistance, must also be considered. We may note here that European engines and rolling stock are undoubtedly more severe upon the track, especially at curves, owing to their rigid wheel base, than the American types of engines and cars, and that with such flexibility of wheel base the increase in operating expenses, due to curvature, is but slight. The report recommended that the gage be widened on curves of less than 3½°, and that rails for curves of less than 9° should be bent before being laid. On sharp curves there should be an ample supply of good ballast on a well drained roadbed to provide against lateral displacement, and means should be taken to prevent the overturning of the rails. Transition curves are recommended. The widening of gage on curves is effected by moving the inner rail, extending the widening on the transition curve.

Steaming Capacity of Locomotive Boilers.—Tests are to be made and reported upon at the next congress as follows: 1, Results obtained with tubes of different diameter, length, pitch, type, metal and arrangement in the boiler; 2, Effect of the size of the smokebox and of different forms of smokestacks and spark arresters; 3, Tests of various forms of exhaust pipes; 4, Tests of the influence of speed upon the production of steam.

High Boiler Pressures (Compound System).—The use of the compound system on locomotives offers, among other advantages, a means of utilizing high pressures, with a consequent economy in fuel and water consumption, while it also gives an increase of power without increasing the wear of the machinery. On the other hand, a certain increase in cost of maintenance and lubrication is admitted for engines having high pressure boilers and more than two cylinders. The number and arrangement of cylinders, as well as the use of an automatic starting valve, were considered as matters of detail, and further investigations were recommended.

High Boiler Pressures (Distribution of Steam).—In view of the general use of balanced slide valves on American locomotives, it was recommended that the use of such valves should be reported upon at the next congress. It is possible that the piston valves used on the Baldwin compound locomotives will also be considered.

Rolling Stock for Lines with Light Traffic.—For some railway systems it is advisable to adopt special light rolling stock for branch and feeder lines with small traffic. In other cases it may be advisable to employ rolling stock similar to that of the main lines, often utilizing the older cars for this service.

Continuous Heating for Trains.—The original report recommended that railways requiring to heat their cars for several months of the year should adopt continuous heating by steam from the locomotive, and that ordinary stoves should be entirely abandoned. This, however, was thought to be too sweeping, several members preferring independent apparatus. The conclusion finally formulated by the congress was that while continuous heating may present advantages for severe climates, it is not generally adopted for other conditions. The congress was evidently ill informed as to practice in this country.

Engine Crews.—The complete chain-gang system, which would leave no reserve of engines, should be entirely abandoned, and the general chain-gang system is not advisable for ordinary service (except in special cases), but the double-crew system offers many advantages.

Locomotive Details.—The congress adopted a standard list of complete dimensions and details to be furnished in order to compare methods of practice on various railways. Tubes and tube-plate leakages are to be considered at the next congress.

Signals and the Block System.—For fixed signals there is an increasing tendency toward the adoption of the normal position at "track blocked" or "danger," and this is already in force on several railways for drawbridges, junctions, crossings, etc., as well as at important stations, but for less important stations the normal position at "track clear" seems to be preferred. Block signals are always normally at "track blocked" on single track roads, but at "track clear" on double-track roads, except those having very heavy traffic. There is a tendency to work the telegraph signals between the operators in conjunction with the track signals; in other words, to adopt the lock-and-block system. Signal systems which are exclusively automatic were not thought to afford sufficient security in operation.

Lighting Signals.—Tests of the power of light through colored glass indicate that violet should be avoided. There is a tendency toward the use of lamps with petroleum oil and circular wicks, which give a more intense light than vegetable oil and flat wicks, and are very rarely extinguished. Good results are expected from the use of the electric light.

Train Signals.—For intercommunication signals on trains, there are in use bell cords and devices worked by electricity, vacuum or compressed air, any of the latter being preferable to the cord for long passenger trains. Communication between stations and running trains has been carried on experimentally, but further experience is necessary before any conclusion can be arrived at as to its practical operation.

Interchange of Rolling Stock.—The practice varies in different countries, but in general there is a system of compensation on a basis of mileage and time, with fines for detention.

Railways with Light Traffic.—The congress noted with pleasure the general tendency of companies and public administrations to introduce greater simplicity in the methods of regulating and operating lines with light traffic which form part of a standard gage system.

Railways in New Countries.—Railways play an important part in the development and civilization of new countries, and where direct benefits will not immediately accrue it is generally necessary for the state to aid the enterprise, either by building lines itself or by granting subsidies and concessions to companies. When the traffic is very light, the utmost economy must be observed, and in such cases a narrow gage may be adopted. As a rule it is considered better to push work from one end, rather than to commence construction at several points.

Interstate Traffic.—While it may be difficult to arrive at any international arrangements for slow freight traffic, it is considered desirable and practicable to establish uniform rates for the through transportation of fast freight. The administration of the Belgian state railways, which has direct relations with nearly all the principal European railways, has been asked to prepare a uniform international rate for fast freight, with arrangements for the distribution of cost.

Superannuation of Employees.—The congress considered that railway companies and administrations are under a moral obligation to care for old employees and their families, and this may be done either by superannuation funds, pensions, or some insurance system.

Light Railways.—Several members opposed the 24-in. gage on account of the necessarily slow speed, and of the lack of convenience of the passenger cars. Speeds of 31 to 37 miles per hour on the meter gage were instanced, and some members thought the speed an unimportant consideration for such lines. The conclusions arrived at were that there should be greater latitude in regard to the gage, but that, on the other hand, it is best to keep as far as possible to certain types which have already been approved in practice. The only gages recommended were 4 ft. 8½ ins., 3 ft. 3⅜ ins., 2 ft. 6 ins. and 2 ft. Steam locomotives can be operated satisfactorily and without nuisance on lines laid along highways. The width of car body was recommended to be three times the gage, the interior arrangement to depend upon the nature and amount of traffic. Large cars on trucks are in general preferable, but, in view of the relation of dead load to live load, small cars may be required on lines with light traffic. A combined central coupling and buffer was recommended.

Track Cars.—Track cars operated by hand levers or pedals are of much importance for track inspection and general track work. Experiments with steam cars are considered desirable, and such cars might be used to carry the mails on lines with light traffic, either to establish additional service or to replace an expensive mail train service.

The following subjects were also considered: Control of speed of trains, distribution of empty freight cars, station agents, statistics of cars, union stations, rates and traffic and special system of traction. The following subjects were postponed for discussion at the next congress: Uniform technical nomenclature, switches and frogs, effect of wheels on rails, wooden ties and variation of gage of wheels, light railways and feeder lines.

A DUPLEX SLIDE RULE.

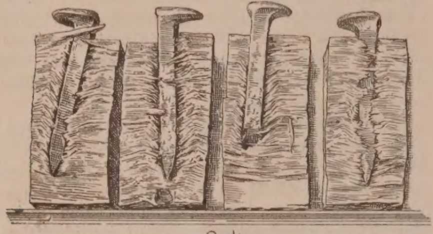
An improved form of the "Mannheim" slide rule has been invented and patented by Mr. William Cox, of New York. The chief difference between this and the older rule is that the slide itself is of the same thickness as the rule, and consequently has its two faces flush with those of the rule. Both sides of the slide are graduated, while the graduations of the rule are alike on both faces. On one face the two scales of the slide are graduated in the usual manner; but on the other face the graduations are in reversed order, the scales progressing toward the left. This latter plan is equivalent to reversing the slide itself, with advantages at once apparent. The right and left indices of the four different scales on the reversed face of the rule coincide with those of the scales on the ordinary or upper face, and a metallic runner, encircling the whole rule, enables coinciding points on any scale of either face to be at once found.

Among the many advantages of this form of rule may be mentioned the following: The area of a circle, emboding the product of three factors, is found by a single operation; the cube of a number is found in the same way, and among the other problems more easily solved than before are the obtaining the diameters and revolution of wheels, the diameter and revolutions of a pulley with a given belt-speed per minute, and lastly, to obtain at one and the same setting the square, cube, fourth, fifth and sixth powers of a number, or the square root of the fifth power.

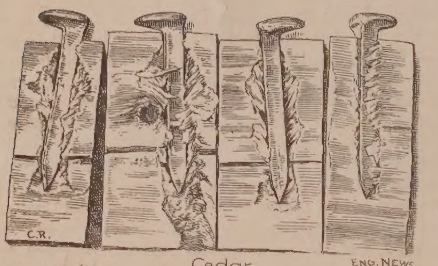
Fuller particulars of the many uses of this improved rule are contained in a pamphlet, written by Mr. Cox, and supplied, along with the duplex slide rule, for $6.50, by the Keuffel & Esser Co., of New York. The new rule facilitates the working out of numerous problems which formerly required the rule to be inverted, a process always accompanied by more or less annoyance to the user.

EFFECT OF DRIVING SPIKES.

The destructive effect of driving spikes in wooden ties is well known and has been illustrated in our columns. We have received from a correspondent on the Atchison, Topeka & Santa Fe R. R., in Kansas, a photograph from which we have prepared the accompanying cut, showing the effect of spikes driven into oak ties and cedar ties. After the spikes were driven the ties were sawed into small blocks inclosing the spikes, and these blocks were subsequently split open at the spike holes.



Oak.



Cedar.

Effect of Driviing Spikes in Wooden Ties.

AN INDIAN METHOD OF TESTING LIME FOR MORTAR.

Mr. R. S. Weston sends to "Indian Engineering" the following method of testing lime for mortar: Erect a pillar about a foot high, just for convenience sake, as a basis for a practical test, and having a hollow about ¼ in. deep in its upper surface in which two bricks will fit tightly. Then have the mortar prepared from the lime at hand, say, 1 of lime and 3 of soorkee, or fine sand; then after soaking about six or eight bricks, build them in the hollow in the pillar, two headers over two stretchers, etc., keeping them moist with water for a few hours till set, after which, if this masonry is struck vertically with a wooden mallet and it is found that the mortar is hard and brittle and that the bricks break before the mortar (though the bricks are well burned), it may be taken for a certainty that the lime used is good; after which it might be locked up and kept from being tampered with. This is the best practical test that I know of, and I have had experience in lime and brick-burning, says Mr. Weston.

PERSONALS.

Mr. Lucius E. Marple has been appointed Consulting Electrical Engineer of the Montreal Park & Island Ry. Co., Montreal, Canada.

Mr. W. H. Cadwell has been appointed engineer of construction at the Shuttle Meadow reservoir dam, New Britain, Conn., vice Mr. Bancroft. Mr. Blake is Consulting Engineer.

Mr. W. M. Hughes has resigned his position as City Bridge Engineer of Chicago to accept the position of Principal Assistant Engineer of the Metropolitan Elevated R R., Chicago.

Mr. A. W. Gibbs, Assistant Superintendent of Motive Power of the Richmond & Danville R. R., has been appointed Assistant Mechanical Engineer of the Pennsylvania R. R., with office at Altoona, Pa.

Mr. Alfred F. Noyes, City Engineer of Newton, Mass., has resigned, and the City Council has appointed a special committee to prepare resolutions expressing appreciation of his services.

Mr. J. B. Morford has been appointed Superintendent of the Canada and Michigan Midland divisions of the Michigan Central R. R., with headquarters at St. Thomas, Ont., vice Mr. O. F. Jordan, transferred.

Mr. H. H. S. Handy, Division Engineer of Maintenance of Way on the Norfolk & Western R. R., has been promoted to be Superintendent of the Winston-Salem Division, vice Mr. H. Barger, transferred to the Kenova Division.

Mr. O. F. Jordan, Superintendent of the Canada and Michigan Midland divisions of the Michigan Central R. R., has been appointed Superintendent of the Middle, Air Line, South Haven and Grand Rapids divisions, with headquarters at Jackson, Mich., vice Mr. C. B. Bush, deceased.

Mr. F. H. Kirkpatrick, of Bangor, Me., died July 22 at Grassmere, Staten Island, at the residence of M. E. Reed, President of the Richmond & Chesapeake R. R. Mr. Kirkpatrick was Resident Engineer of this railway, which is building a tunnel under Eighth St., Richmond, Va. He was formerly engaged on the Maryland Central R. R. and Baltimore Belt R. R.

Mr. J. M. Meade, Resident Engineer of the Atchison Topeka & Santa Fe R. R., at Topeka, Kan., has been assigned to the western grand division, which includes all the Santa Fe lines in Kansas west of Dodge City and in Colorado, New Mexico and Texas. Mr. E. W. Grant, recently resident engineer at Las Vegas, has been appointed assistant to Mr. Meade, with headquarters at La Junta.

Mr. E. W. Groves, for the last three years engineer in charge of the Austin dam, has resigned his office and in a letter to the Board of Public Works states his reasons. These are, in brief, that Mr. John McDonald, Mayor of Austin and President of the Board of Public Works, has been constantly interfering with the conduct of the engineering work, and as constantly countermanding the orders of the engineer. Mr. McDonald, by letter, denies this change, and says that Mr. Groves will not be guided by advice, and will not listen to reason. The resignation of Mr. Groves was accepted by the board, and Mr. Fanning, the consulting engineer, is requested to provide another engineer in charge.

An endless chain carrier to convey logs down a decline 2,500 ft. long is being constructed in the northwest wilderness of Maine by a syndicate which has purchased the timber lands of seven townships. The carrier begins at the edge of a dam which has been constructed across the Penobscot River at Seboomook, where the logs are collected, and conveys the logs to Carry Brook, through which they reach Moosehead Lake, and, eventually, by the Kennebec River, the mills at Gardiner. As described, the chain is of steel with links 1 ft. long. Every eight feet there is a "chair," or bar, running across the chain, and on either end of the bar are iron standards to hold the log in place. The carrier runs in a trough. The motive power will be two 40-HP. engines; one located at the center and the other at the upper end. It is stated that the chain will move at the rate of 200 ft. per minute and convey 8,000 pieces, or about 1,000 M. ft. B. M., every 24 hours. The estimated cost of conveying the logs is 25 cts. per 1,000.

NEW PUBLICATIONS.

TIMBER PHYSICS. Part II. Results of Investigations on Long-Leaf Pine. Forestry Division, U. S. Department of Agriculture, Bulletin No. 8. B. E. Fernow, Chief of Bureau. Government Printing Office: Washington, D. C. 4to; paper; 92 pp. and 12 plates.

This last bulletin of the bureau, treating of the physical qualities of long-leaf pine, bled and unbled, takes up the subject under the following heads: Mechanical tests at the Washington University testing laboratory; the characteristics and location of long leaf pine; results of mechanical tests; field report on turpentine timber; resinous contents and their distribution in long-leaf pine, and field records of test materials. The bulletin fully illustrates the testing laboratory, and its apparatus, together with diagrams of physical tests. The methods for chemically analyzing the turpentine are also illustrated and described. Taken altogether, this series of reports is of the greatest value in determining the qualities of one of the commonest materials of construction and the thorough manner in which the subject is treated reflects the greatest credit upon the gentlemen engaged in this laudable work. The importance of these investigations to the community can be better understood when it is stated that this long-leaf pine timber is probably the strongest timber in large size to be obtained in the United States, and is one of the most used in heavy construction. Oak and hickory in small selected specimens may exceed it in strength and toughness; but the latter wood is scarce, and oak in large sizes is usually more or less cross-grained, knotty and season-checked, so that it will average much lower in strength than long-leaf pine, which is generally free from these defects. This bulletin compares the long-leaf with the short-leaf yellow pine and white pine, and concludes that in strength they rank very nearly in direct proportion to their relative weight, which ranks in the order given. Pound for pound, they seem to be of about equal strength; but as the long-leaf is so much heavier than the other varieties its strength for given sizes is much greater.

A MANUAL OF LIME AND CEMENT: Their Treatment and Use in Construction. By A. H. Heath. London and New York, 1893: E. & F. N. Spon. 8vo; cloth; illustrated; pp. 215; with index. Price, $2.50.

The contents of this neat little volume are pretty clearly indicated in the title. As it describes English practice mainly, the greater portion is naturally devoted to the treatment and use of English Portland cement, although the principal European and American cements and limes are briefly touched upon. The book is chiefly valuable, however, for its treatment of English Portland cement, and in this evidences wide reading in the literature of the subject and painstaking labor in sifting from it the few proved facts and accepted theories, and condensing them into form for immediate practical use.

The first two chapters discuss limes in general and the more important European and American natural and artificial cements, touching briefly upon their compositions, manufacture and uses. Especially interesting to American engineers are the brief summaries of the sources, compositions and qualities of some of the better known foreign limes and cements, as Santorin earth, lias lime, chaux de Teil, ciment graphier, etc. In Chapter II. the manufacture of Portland cement in England is described, and the effects of the various systems and conditions of manufacture upon its strength discussed. Chapters IV. and V. treat at length of the various methods of testing for tensile, compressive, bending and torsional strengths, rapidity of setting, durability, etc. Both lime and cement mortars are discussed in Chapter VI., and a large amount of information given in reference to the best compositions for mortars for various classes of work and with both natural and artificial sand; their strengths and the effects of admixing adulterants. Chapter VII. describes the making of concrete, its uses, strength, etc., and Chapter VIII. describes its use in sea water. This last chapter is especially interesting as summarizing the recent discussion on the disintegration of concrete in sea water. In the appendix the manufacture of Kankar lime, so much used in India, is described. The book is provided with a fairly good index.

NOTES ON MITERING LOCK GATES.—By First Lieutenant Harry F. Hodges, Corps of Engineers U. S. A. Prefossional Papers of the Corps of Engineers U. S. A., No. 26. Washington, D. C. 4to; 132 pp.

In this latest contribution to the engineering literature on lock gates, Lieutenant Hodges commences with the mathematics of water pressure on lock gates; the author then takes up in sequence gates with straight and curved backs, the framing and sheathing of gates and their strains and operation. The work concludes with illustrations and brief descriptions of a number of dock gates in England, France and the United States. The author goes into the full detail of his subject, and his conscientious work will be appreciated by many engineers now interested in the construction and operation of lock gates for heavy lifts.

THE COMPASS.—A Monthly Journal for Engineers, Surveyors, Architects, Draftsmen and Students. Vol. 2. Edited by Wm. Cox. New York. Keuffel & Esser Co. 8vo; p. 192. $1 per year.

The second volume of this excellent little serial, devoted primarily to engineering instruments and the formulas and processes affecting their use, is fully up to the standard of the first volume, which was a very high one. It contains a great deal relating to surveying and the use of instruments, which is of interest and value; its editor, Mr. Wm. Cox, being an accomplished and ingenious mathematician, as his frequent contributions to our columns will bear witness. Though primarily undertaken, beyond doubt, to advance the business interests of its publishers, it is conducted in a truly scientific spirit, and so far as we have observed them its statements are trustworthy and unexaggerated.

FOREST INFLUENCES.—Bulletin No. 7. Forestry Division, U. S. Department of Agriculture. Washington, D. C.: Government Printing Office. 8vo. 197 pp.

A great part of the work in this bulletin is performed by Mr. B. E. Fernow, Chief of the Forestry Division. The four chief divisions have the following subject heads: Introduction and summary of conclusions; review of forest meteorological observations (by Mr. M. W. Harrington, Chief of the Weather Bureau) relation of forest to water supplies: and notes on the sanitary significance of forests. The two appendices are: Determination of the true amount of precipitation and its bearing on theories of forest influences, by Prof. Cleveland Abbe, and the analysis of rainfall with relation to surface conditions, by George E. Curtiss. These several contributions practically sum up the data available for coming to conclusions upon this important subject, point out some of the difficulties presented by the absence of sufficiently extended and reliable observations on rainfall in this connection and present certain theories which should assist in developing true conceptions as to cause and effect and the possible relation of surface conditions to rainfall.

U. S. GEOLOGICAL SURVEY. Bulletins Nos. 82 to 85 and Nos. 90 to 96. Washington, D. C.

These bulletins treat of the following subject matter: No 90, report of work done in the Division of Chemistry and Physics, 1890-91; No. 91, Record of North American Geology for 1890; No. 92, the Compressibility of Liquids; No. 93, Insects from Florissant, Colo., and other points in Colorado and Utah; No. 94, The Mechanism of Solid Viscosity; No. 95, Earthquakes in California, 1890-91; No. 96, The Volume Thermodynamics of Liquids; Nos. 82 to 85, Correlation Papers on the Cretaceous, Eocene, Neocene and Newark systems.

GEOLOGY OF THE EUREKA DISTRICT, NEVADA. With an Atlas. By Arnold Hague. U. S. Geological Survey, Monograph No. XX., Washington, D. C. 4to. 418 pp. With plates, Atlas, 13 double maps, colored. $5.25.

The fieldwork for this survey was done in 1880. The monograph itself is purely geological in its scope, and is a careful study of a comparatively small block of mountains called the Eureka Mountains. The maps are uniform with those already published by the U. S. Geological Survey, and nothing more need be said of their admirable qualities.

THE FLORA OF THE DAKOTA GROUP. A Posthumous work. By Leo Lesquereux, edited by F. H. Knowlton. U. S. Geological Survey. Monograph XVII. Washington, D. C. 4to; 400 pp. and many plates. $1.10.

GASTEROPODA AND CEPHALOPODA OF THE RARITAN CLAYS AND GREENSAND MARLS OF NEW JERSEY. By Robert Parr Whitfield. U. S. Geological Survey. Monograph No. XVIII. Washington, D. C., 4to. 402 pp. and many plates. $1.00.

PRESENT DEVELOPMENT OF HEAVY ORDNANCE IN THE UNITED STATES.—By W. H. Jaques, Ordnance Engineer. Reprinted from Franklin Institute Journal. July, 1893. Pamp.; 8vo; 35 pp.

In this reprint of his lecture before the Franklin Institute, this eminent authority on ordnance sketches the progress made in the United States during the last ten years. Into this discussion enter the subjects of decrease in the parts of guns, the new powders, the built-up forged steel gun, the production of open-hearth steel, forging, etc.

THE ELECTRIC TRANSMISSION OF INTELLIGENCE. By Edwin J. Houston, A. M. New York, W. J. Johnston. Co., L'd: London, Whittaker & Co. Cloth; 12mo; pp. 330; 88 illustrations. Price $1.

The third and concluding volume of Professor Houston's advanced primers of electricity is devoted to the telegraph, the telephone, electrolysis, electro-metallurgy, storage batteries, electrotherapeutics, electric annunciators and alarms, electric welding, electricity in warfare, and several miscellaneous applications of electricity. In this, as in the primers on multiple and cable telegraph and telephone work the author has so treated his subjects as to make the measily understood by any reader. There are numerous extracts from standard works on the subjects treated.

INDIANA ENGINEERING SOCIETY.—Proceedings of the Thirteenth Annual Meeting, held at South Bend, Ind., Jan. 23, 24 and 25. 8vo; pp. 146. Secretary, W. P. Carmichael, Williamsport, Ind. Price, 50 cts.

In addition to the reports of proceedings, addresses, etc., there are reports of committees on Legislation, Drainage, and Engineering and Surveying, and also the following papers: "Hydraulic Cements," M. J. McCue; "Heterodoxical Methods in Sewer Construction," W. M. Whitten; "The Timmons Drainage Law," M. A. Rader; "Field Notes of an Old Surveyor," R. I. Morrison; "Surveys in Court," R. A. Howard; "Stadia Measurement in Land Surveying," J. W. Fawcett; "In the Mountains of Utah," F. Hodgman.

TRADE PUBLICATIONS.

COLD SAW MACHINES.—Newton Machine Tool Works, Philadelphia, Pa. 8vo; pp. 60; illustrated.

This is a special catalogue of cold saw cutting-off machines for bars, shapes and other iron, ranging from light sections to steel castings and armor plate. Band saws and saw sharpening machines are also included. About 30 pages are devoted to tesimonials.

PUMP GOVERNOR.—Fisher Governor Co., Marshalltown, Ia. 16mo, pp. 56.

This is a pamphlet of testimonials, with some particulars of the Fisher steam pump governors, gravity governors for steam pumps filling elevated tanks, and reducing valves for steam, gas or air.

HYDRAULIC TOOLS, CRANES AND MACHINERY.—R. D. Wood & Co., Philadelphia, Pa. 8vo; pp. 24; illustrated.

Among the tools illustrated are riveters, punches, shears, etc., for different classes of work; cranes, turbines, etc.; also tables of weight and size of pipe, and particulars of hydrants, valves, stand-pipes, water towers and gas holders. A view is given of a hydraulic traveling crane 150 ft. span, with a capacity of 6,000 lbs.

SOCIETY PROCEEDINGS.

ENGINEERING ASSOCIATION OF THE SOUTH.—At the meeting at Nashville, Tenn., July 13, the subject of "Smoke Prevention" was presented by Prof. Olin H. Landreth, of Vanderbilt University. The paper discussed, successively, the causes, the effects and the remedies. Objectionable smoke comes mostly from bituminous coal, other fuels producing very little smoke. When fresh coal is thrown on incandescent coal, there at once begins the distillation of the more volatile hydro-carbons, which distilled matter is burned if sufficient oxygen is present and the temperature is sufficiently high, but which otherwise passes up the chimney as yellowish fumes. As the fresh coal becomes more highly heated the less volatile hydro-carbons are distilled, and are decomposed at a temperature much below that necessary for the combustion of the carbon liberated, about 2,000° F., a temperature so high as to give considerable margin of opportunity for this portion of the carbon to escape unburned. It is this free, unburned carbon in a finely divided state that, while incandescent, produces the luminous flame and, when cooled, the clouds of smoke that issue from the chimney and afterward settle as soot. After the volatile matter is driven off the fixed carbon remains and in burning produces but little flame and no smoke, since the particles of carbon are not detached from the solid mass till combustion takes place. As to the effects of smoke production, the fuel loss in the smoke itself is but small, estimated at one-sixth of 1%, but the causes of smoke are also the causes of imperfect combustion, and the consequent waste of fuel in the form of invisible gases, carbonic oxide and light hydrocarbons, and the presence of smoke indicates this parallel waste. Aside from the fuel waste, the effects of smoke outside the furnace make its abatement of public interest. It is authoritatively stated that the residuum of smoke in the lungs induces consumption of an incurable character; and that, in the city of Pittsburg, Pa., the death rate was 1.62 per 1,000 lower during the eight years in which the use of natural gas almost freed the city from smoke, as compared with the preceding eight years; and that, since the partial return of the smoke the rate has increased 2.57 per 1,000. Carbon in a finely divided state is an easy vehicle both for noxious gases and organic impurities. The insidious soot pervades and defaces public and private buildings, and calls for fruitless efforts for cleanliness, when cleanliness is impossible. Smoke is objectionable from the loss of light and increased cost of artificial light; also from the repression of aesthetic tendencies and consequent mental and moral discouragement. Consideration of the causes suggests the agencies and the mechanical devices for the prevention of smoke; these latter, so far as pertains to steam boilers, are classed as mechanical stokers, air flues in the walls and grate bars, coking arches, dead plates, down-draft furnaces, steam jets for injecting air and mixing the gases, baffle plates and double furnaces. Smoke prevention must be accomplished by educating the public to consider smoke a nuisance that unquestionably can and should be abated, for the smoke producers are very slow to be convinced that this abatement is to their interest. Following the influence of public sentiment, laws are to be enacted, and provision made for their enforcement and for furnishing to smoke producers, when desired, professional advice regarding the means and appliances for smoke prevention. The paper gives the statutes passed in Chicago, Cincinnati, Cleveland, Pittsburg, New York, Rochester, Boston, Denver, the state of Ohio and the city of Birmingham, England, with statements of the success attained in preventing smoke in these localities, success in such cases being proportional to the vigor of the action taken. The paper contains descriptions of various mechanical devices for smoke consumption, and closes with a list of literature on the subject.

The next meeting of the Association will be held Sept. 14. Walter G. Kirkpatrick, Secy.

CIVIL ENGINEERS' CLUB OF CLEVELAND.—At the meeting on July 11, the president in the chair, and 17 members and visitors present. Mr. E. P. Roberts read a paper on "Preliminary Surveys for Electric Light Stations." Frank C. Osborn, Secy.

AMERICAN INSTITUTE OF ARCHITECTS.—The annual convention is to be held at Chicago, on July 31 and Aug. 1, to be followed by the International Congress of Architects on the subsequent days of the same week. In addition to the papers already announced (Eng. News, July 6), one has been promised by W. W. Carlin, of Buffalo, N. Y., on "Statutory Regulations," and one by R. Guastavino on "Cohesive Construction, the Past, the Present, the Future." Alfred Stone, Secy.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Through the efforts of Mr. H. F. J. Porter, Assistant Chief of the Machinery Department at the World's Columbian Exposition, a program of entertainment has been arranged for the afternoon of Monday, July 31, for visiting members of the society and their foreign guests. The morning session of the mechanical section of the Engineering Congress will close in time for luncheon, and the guests are then invited to embark on the whaleback steamer "Christopher Columbus," which leaves the dock at the foot of Van Buren St., near the Art Institute, at 2 p. m., for Jackson Park. On arriving at the grounds the visitors will be taken up the Casino pier on the movable sidewalk, and will then assemble in Music Hall, near the end of the pier, where a description of some of the principal engineering features of the fair will be made by members of its engineering staff. Maps showing the progress by months of the Exposition will be shown. Afterward the members are invited to cross the Court of Honor to the Worthington pumping station, where a light lunch will be served.

SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.—The list of officers of this society is as follows: President, E. Lee Heidenreich; Vice-Presidents, I. G. Graver and E. Moyel; Treasurer, Karl L. Lehmann; Secretary, Allan Strale. A reunion of Scandinavian engineers will be held at the Art Palace, Chicago, next week, under the auspices of this society. The offices are in the Title and Trust Building, 100 Washington St., Chicago.

COMING TECHNICAL MEETINGS.

AMERICAN INSTITUTE OF MINING ENGINEERS.
July 31 to Aug. 5. Chicago, Ill. Secy., R. W. Raymond, 18 Burling Slip, New York.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
July 31 to Aug. 5. Annual Convention at Chicago. Secy., F. Collingwood, 127 East 23d St., New York.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
July 31 to Aug. 5. Annual Convention at Chicago. Secy., F. R. Hutton, 12 W. 31st St., New York.

DEUTSCH-AMERIKAN TECHNIKER VERBAND.
Aug. 1 to 6. Annual meeting at Chicago. Secy., A. Nutick, Pittsburg, Pa.

WESTERN SOCIETY OF ENGINEERS.
Aug. 2. Secy., Jno. W. Weston, 51 Lakeside Bldg., Chicago.

ENGINEERS' CLUB OF ST. LOUIS.
Aug. 2. Secy., Arthur Thacher, Odd Fellows' Building.

ENGINEERS' CLUB OF MINNEAPOLIS.
Aug. 3. Secy., E. Nexsen, 504 Kasota Block.

ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
Aug. 4. Secy., F. K. Smoot, 808 Commerce St.

TECHNICAL SOCIETY OF THE PACIFIC COAST.
Aug. 4. Secy., O. Von Geldern, 719 Market St., San Francisco.

SWEDISH ENGINEERS' CLUB.
Aug. 5. Secy., P. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 180 La Salle St., Chicago. Secy., John Ericson.

NORTHWEST RAILROAD CLUB.
Aug. 8 Secy., W. D. Crosman. Ryan Hotel, St. Paul.

NORTHWESTERN SOCIETY OF ENGINEERS.
Aug. 8. Secy., D. W. McMorris, Burke Block, Seattle, Wash.

DENVER SOCIETY OF CIVIL ENGINEERS.
Aug. 8. Secy., F. E. King, Jacobson Block.

CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
Aug. 9. Wichita, Kan.

ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
Aug. 10. Secy., F. W. Mowbray, Norton Building.

NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Aug. 11. Secy., D. W. Meeker, St. Paul.

MONTANA SOCIETY OF CIVIL ENGINEERS.
Aug. 12. Secy., G. O. Foss, Helena.

ENGINEERS' CLUB OF KANSAS CITY.
Aug. 14. Secy., Waterman Stone, Baird Building.

WISCONSIN POLYTECHNIC SOCIETY.
Aug. 14. Secy., M. F. Schinke, City Hall.

COLUMBIAN ENGINEERING SOCIETY.
Aug. 15. Secy., F. W. Hart, Washington, D. C.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Aug. 15. Secy., R. H. Clark, Pittsburg.

SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
Aug. 17. Secy., C. F. Franson, Portland Block.

TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS.
Aug. 18. 201 Washington Building.

ENGINEERS' SOCIETY OF PHŒNIXVILLE.
Sept. 5. Secy., W. Halliburton.

CIVIL ENGINEERS' CLUB OF CLEVELAND.
Sept. 12. Secy., F. C. Osborn, Case Library Bldg.

NEW ENGLAND RAILROAD CLUB.
Sept 13. Secy. F. M Curtis. O. C. R. R., Boston.

ENGINEERING ASSOCIATION OF THE SOUTH.
Sept. 14. Secy., W. G. Kirkpatrick, Nashville, Tenn.

WESTERN RAILWAY CLUB.
Sept. 19. Secy., Clement F. Street, Chicago.

ASSOCIATION OF ENGINEERS OF VIRGINIA.
Sept. 20. Secy., L. V. Carmalt, Roanoke, Va.

BOSTON SOCIETY OF CIVIL ENGINEERS.
Sept. 20. Secy., S. E. Tinkham, 36 Broomfield St.

NEW YORK RAILROAD CLUB.
Sept. 21. Secy., John A. Hill, Temple Court, N. Y.

ENGINEERS' CLUB OF CINCINNATI.
Sept. 21. Secy., J. F. Wilson, 24 W. 4th St.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB
Sept 21. Secy., S. A. Charpiot, Macon, Ga.

CANADIAN SOCIETY OF CIVIL ENGINEERS.
Sept. 22. Secy., C. H. McLeod, Montreal, P. Q.

CENTRAL RAILWAY CLUB.
Sept. 27. Secy., S. W. Spear, Buffalo, N. Y.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Oct. 2. Secy., C. L. Annan, City Engineer's Office.

ENGINEERS' CLUB OF PHILADELPHIA.
Oct. 7. Secy., L. F. Rondinella, 1122 Girard St.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York,
Entered at the Post Office. New York City,
as Second Class Matter

VOL. XXX. THURSDAY, JULY 27, 1893.

D. MCN. STAUFFER, A. M. WELLINGTON.....EDITORS
CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, C. S. HILL } ASSOCIATE EDITORS
GEO. H. FROST........................BUSINESS MANAGER

Chicago Office : Monadnock Building.
F. A. PECKHAM..................................MANAGER

EUROPEAN AGENCIES.

KEGAN PAUL, TRENCH, TRUEBNER & Co. (Limited), Paternoster House, Charing Cross Road, London, Eng.
SAMPSON LOW, MARSTON & Co (Limited), St. Dunstan's House, Fetter Lane, London, Eng.

SUBSCRIPTION RATES: One year, $5.00; 6 months, $2.50: 4 months, $2.00; single copies 15 cents. To all foreign countries in the Postal Union, add $2.08 to above prices for postage. Subscribers can have the mailing address of their paper changed as often as they desire. They should send both the old and the new addresses. No club rates are allowed.

The date when the subscription expires is on the address label on each paper, the change of which to a subsequent date becomes a receipt for remittance. No other receipt is sent unless requested.

ADVERTISING RATES: 20 cents per line agate measure. Schedule sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements, not later than Wednesday noon. The last pages go to press early on Thursday. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

The headquarters of Engineering News on the grounds of the World's Columbian Exposition are at Section K, Aisle 37, of Machinery Hall (central aisle, just west of the large water tank), and at Section U N, Posts 10 to 11 (office No. 9), of the Transportation Building Annex, at the west end of the Great Britain railway exhibit. For the convenience of subscribers and advertisers, it is announced that some member of the editorial staff of this journal may be found at the first-named office, in Machinery Hall, from 10 to 10:25 a. m., of each week day, and from 10:35 to 11 a. m. at the second-named office, in the Transportation Building; as also frequently at other times. Appointments may be made by calling at our downtown Chicago office in the Monadnock Building.

The Engineering Headquarters, at Chicago, are at No. 10 Van Buren St., directly opposite the viaduct leading to the Illinois Central R. R. World's Fair trains, and to the steamboat pier, and but a stone's throw from it. The rooms are large and comfortable, and include reading, writing, smoking and other apartments. The rooms are to be kept open during the Fair by subscriptions of engineers, and all American and foreign engineers visiting Chicago are invited to register and make free use of the rooms during their stay, and to have their mail addressed there. An informal reception is held at these rooms every Monday evening from 8 to 10 p. m.

* * *

If any one desires a good illustration of the fact that Americans have made vast progress in good taste during the 17 years which have elapsed since the Centennial Exposition, he can find one by comparing the typical American locomotive of 1876 with that of to-day. In the wonderful exhibit of railway progress made by the Baltimore & Ohio, at the World's Columbian Exposition, there is a B. & O. locomotive of 1876, which is fairly representative of the locomotives which were in regular service at that time. The chief transgression of the canons of good taste by locomotive builders a score of years ago was in painting. Driving wheels and truck wheels were painted a brilliant vermilion. No other color was considered striking enough for the legs of the "fiery steed." The stack often suffered, and occasionally suffers still, in the same way. Besides this, striped work was everywhere, and the more different colors a painter could get on in striping the panels of the cab, the higher did he rate the result of his labor as a work of art. Besides this, the machinist delighted in putting on polished brass wherever an opportunity could be made. Boiler and cylinder jacket rings, cylinder covers, hand rails on running boards, pump details, and cocks and valves everywhere were among the parts which the hostler had to laboriously polish after every run. The climax was capped when the Grant Locomotive Works sent that nickel-plated locomotive to the Paris Exposition of 1879, and since then an era of good taste has been rapidly dawning in this department of industry.

* * *

The American locomotives exhibited at the World's Columbian Exposition fairly represent the current practice of the best railways and locomotive builders at the present day; and they must be pronounced by any unprejudiced critic to be equal or superior in appearance to the locomotives of any other nation. The only other engines shown which compare with them, so far as good taste in design is concerned, are the British engines. The British railways follow the practice of painting the boiler instead of using bright Russia iron jacketing (which practice is also followed by the Grand Trunk Ry., of Canada), and each railway has a distinctive scheme of color, the body color being picked out with striping of contrasting colors, as described in the "Notes on English Railways," in our volume for the first half of 1891. The French locomotives, which one might naturally expect to be designed with better taste than those of any other nation, are really the worst of all. In fact, in their use of bright colors in painting and in the multiplicity of detail and profusion of bright parts, the French locomotives remind one strongly of the American locomotives of which we were so proud a score of years ago. Apparently French locomotive designers believe in the Ruskin idea, that all railway machinery is essentially a hideous monstrosity, and hence conclude that any effect for good taste in its design is superfluous.

* * *

Some of the Boston papers, as notably the "Traveller," are urging with much earnestness that the construction of the Tremont St. subway as authorized by the last legislature be proceeded with without delay, and we apprehend that their appeals will be heeded, though the predilections of the political authorities, for some reason or other, seem to favor the more expensive elevated railway project. As this latter, however, unlike the subway, cannot be carried out unless the people vote in favor of it, and it requires that the right of way shall be purchased by the city and given to the company which may undertake to build it (should any appear) there is little likelihood that the people will approve it or that it will be carried out, until the far cheaper subway expedient has been first tried and found inadequate.

The friends of the subway, however, may well cry: "Save me from my friends." The usual irruption when any new project is on the tapis, of volunteer plans, has broken out, and all of these plans as yet published show a sad lack of forethought. It may be taken as certain that the success of such a subway will depend very largely upon its details, and especially in these three respects: First, it must be very easily accessible from the street, and hence must save every inch of needless height; secondly, it must be a cheerful and attractive place, with careful attention to appearance in every detail; thirdly, it must be easily accessible at every street corner and without detracting from the present surface conveniences. All three of these conditions are violated conspicuously in some of the plans which we have seen, and some of them in all. The question of height seems to be the most general cause of error. Apparently the volunteer designers seem to have a fixed conviction that each car's "broomstick" must have at least 5 ft. of clearance for its sole use or electricity will not run down it, and to this clearance some of the plans add 7 or 8 ft. more for a cross-footway above the tracks, and a roof 4 to 5 ft. thick above that, including 8 ins. for a stone pavement. No particular effort is visible in any of the plans to secure that stately colonnade effect which may be so easily secured by being a little more economical in construction, and which is so impressive in all subterranean chambers, and the favorite place for bringing up stairways seems to be right into the center of the sidewalk above.

* * *

It is to be hoped that wiser counsels will prevail when the work of design is seriously undertaken, in order that the example which Boston seems likely to set for dozens of other cities to follow may be in all respects a good one. The subway may be called the creation of the electric railway, and even of the electric street railway only, since it is only the latter which seems entirely suited for such a system of construction. As Boston has taken the lead of all cities in the world in this particular method of transportation, it is natural that it should also take the lead in building the subway system which is its natural sequel and corollary, and in connection with which the electric street railway, it seems to us, will furnish a quite ideal method of quick transit for the short distances which Boston only needs, though without the subway the electric railway is almost too dangerous for toleration when high speeds are attempted, as both Brooklyn's and Boston's experience has shown.

PUBLIC COMFORT AT CHICAGO AND PHILADELPHIA.

No one consideration has more to do with the total attendance at a great world's fair than the provisions made at it for public comfort, nor is there any surer index, perhaps, of comparative civilization. It is therefore of interest to compare the expositions of 1876 and 1893 in this respect, and on the whole the comparison is reassuring, though there are points of superiority in each, and assuredly the advance of Chicago upon Philadelphia is nothing like as great in this respect as it has been in every other. The advance in every other respect is so enormous, however, that this still leaves room for a decided advance, and on the whole this may be conceded.

The greatest contrast between the two expositions is doubtless in the important matter of transportation to and from the grounds. In this Chicago has much the best of it. Who that visited the Centennial and made his headquarters in the city does not remember the crowd which swarmed on the horse-cars bound for the fair in the morning and repeated the performance in the reverse direction at night? The Pennsylvania R. R. extension to Broad St. Station had not been constructed at that time so that practically the only means of conveyance to the grounds (Eng. News, Jan. 30, 1892) were hacks, horse-cars and "shank's mare." During the months of heavy attendance Philadelphia horse-flesh proved quite unequal to the burden of traffic. The horse-cars were crowded to the last degree, elevated railways, cable-cars and electric cars were not yet, and thousands walked for miles to and from the grounds, from absolute lack of conveyances.

It is true that in 1876 there were already prophecies of better street conveyances. In 1876 the first cable railways had just begun climbing the hilly streets of San Francisco. It was in 1873 that Mr. A. S. Hallidie's Clay St. cable-road, the first ever built, was opened for traffic; and the original cable-car is shown at Chicago this year. In 1876 New York city's first elevated railway was running short trains and carrying few passengers, but disappointing its promoters. The electric railway, however, existed only as a dream in the brain of a few inventors. In 1893 those who ride to Jackson Park come in electric cars, cable cars, elevated cars, railway cars and steamboats. Horse-cars are not to be seen at the gates of the Park, and even carriages are few and far between. On the other hand, at Philadelphia, excursion trains all landed their passengers at the Exposition gates, which is not yet done to any extent at Chicago, though immense provisions for doing so have been made which are as yet unutilized. But, at Chicago people are carried back and forth in comfortable cars with seats for all save during a brief time in the rush hours, and then for all but a few. The means of transit are surprisingly good at Chicago, and leave little to be desired.

So also are the outside means for lodging and eating, as a result of private enterprise in which Chicago has outdone herself. This has removed the need for the admirable organization at Philadelphia by which an agent passed through every train arriving in the city and provided every one who desired with accommodations suited to his purse. Still, the latter plan was by far the more hospitable and civilized, and doubtless resulted in saving thousands of visitors from needless expense or discomfort, or both. There is the ghost of such an organization at Chicago, to which people can apply if they choose, but it is only the ghost; and in neglecting this anxious care to secure to each visitor the best value for his money that the city afforded Chicago has not shown an advance in civilization. It has done so nobly in other respects, however, that this will not be interpreted as a reproach, but the simple fact is that the present abundance of good quarters is solely due to individual over-enterprise in preparing to relieve the visitors of cash rather than to save it for them.

In the matter of transportation about the grounds, the tired visitor found or finds a great lack in each, and doubtless this must be so at any great exposition, from the nature of the case. The water-ways within the Columbian grounds are theoretically a great advance on Philadelphia, but practically they are crowded as much as is convenient and safe by mere sight-seers, and the electric launches (and still more the gondolas) are properly enough managed and used for no other purpose. The charge of 50 cts. for the water circuit, occupying about 45 minutes, is not excessive, and this is now charged for any distance, though at first there was also a short-haul charge of 25 cts.

Practically, therefore, the only internal means of transportation at the Chicago Exposition is the elevated electric railway, charging 10 cts., in contrast with the surface steam railway at Philadelphia, charging 5 cts. (Eng. News, Jan. 30, 1892). Here again, although the contrast in material civilation favors Chicago, the contrast in material civilization favors Philadelphia. The fare of 10 cts. is extortionate and should not have been permitted, especially as it is really one of those cases where greed overreaches itself. We have watched these cars carefully for some months. Four-car trains are run, and rarely if ever is there more than one good carload on the train. If the fare were 5 cts. we deem it quite certain that the trains would run nearly full, but the rate is kept up in hopes that the bigger crowds of late summer and fall will eventually fill the trains despite the 10-ct. fare. We predict that they will not, and that greed will overreach itself hereafter as heretofore. There was far more justification for charging 10 cts. at Philadelphia than at Chicago; because, although the cost of the Chicago road was doubtless four times as great, the crowd at Chicago is more than four times as large, and moreover, the Chicago electric railway was erected to advertise and push the plant for general use as well as for direct profit; and it is but just to say that it is likely to have that effect, as the service is very good. When it comes to charging 30 cts. for a complete circuit of the track, however (and that is what it costs if the passenger gets on at any way station), thousands of people who do not care much for the sum involved will resent the imposition by refusing to ride on it. The Fair management should not have permitted the 10-ct. rate. It was certain to return so little more than the 5-ct. rate, at the best, that the difference was not worth depriving the public of the convenience of cheap rides. This railway, moreover, does not meet all the requirements that might have been foreseen, as pointed out in our issue of Oct. 13, 1892, and it would have been well if some of the suggestions for surface cars, operated by storage battery or other motors, had been carried out, so as to afford conveyance between the entrances, the buildings and the wooded island.

As for the rolling chairs, we do not recall what the regulations were at Philadelphia. The prices at Chicago (40 cts. per hour, without an attendant, or 75 cts. per hour, with one) put them out of reach of the great bulk of patrons of the Exposition. The necessity of some means of getting about the grounds, however, is so urgent that, notwithstanding the high prices, the chair company keeps half or more of its men employed. Evidently a very small reduction would make the supply of chairs and attendants unequal to the demand, and any increase in the number of chairs within the aisles of the buildings would inconveniently crowd them. Therefore the hour rates are as low as they should be, and we think the same as at Philadelphia.

But the Columbian Exposition management has neglected and is neglecting one opportunity to increase receipts and public comfort which hardly existed at Philadelphia. Outside of the buildings, on the broad footways, there is plenty of room for more chairs. It is aggravating to tired sight-seers to see hundreds of idle chairs outside of the buildings for which they would be glad to pay 10 to 50 cts. for transportation from one building to another, but which they cannot use at all unless they take them for an hour and pay 75 cts. for them. If it were known that equitable rates of this kind had been established for outside transportation visitors would not stop to ask the rate but take them whenever the spirit moved, and derive vastly more benefit from them, while the receipts would also benefit—probably double. In neglecting this obvious opportunity Chicago is showing a lack of considerate care for its visitors—and also diminishing the gate-money. Thousands would visit the Exposition oftener if they could have this relief. Thousands more would carry away pleasanter impressions and do that advertising which attracts further visitors more effectually.

Mechanically the Chicago rolling chairs are a great advance on Philadelphia, but any chair grows irksome if sat in for an hour, while a few minutes' ride in it may be most welcome. The Centennial chairs were heavy wooden affairs with ordinary round iron tires, not especially comfortable to ride in or easy to propel. The Columbian chairs are of light wicker with bicycle wheels, ball bearings and pneumatic tires. The push of a finger will propel them on a level floor. At the next great international exposition we shall probably have electrically propelled rolling chairs, and, perhaps, with some encouragement they would have been produced for this one, as a very light motor and battery would propel them slowly. Electric cars through the buildings were proposed for the Paris Exposition of 1889 (Eng. News, Jan. 30, 1892).

A feature of the Exposition grounds which favorably impresses every one, is their cleanliness. Philadelphia did pretty well in this respect, but Chicago does still better. It has been proposed to introduce omnibuses on the grounds, but even the much needed facilities which they would afford can hardly reconcile one to the idea of having the present neatness of the Exposition roadways marred by the horse nuisance. It is tantalizing to think that the streets of every city might be as clean, if we could replace not only the street-car horses, but trucks and carriage horses as well by the electric motor. The gain would come not only through doing away with the tons of daily droppings which now foul the pavement, but through the lessened dust due to the decreased wear on the roadway. On a macadamized street, for example, a large proportion of the wear is due to the horses' hoofs, which constantly tear up and loosen the surface and leave the particles to be crushed to powder under the rolling wheels. With no hoof wear on the street surface dust on a properly made macadamized surface should be nearly eliminated.

But, besides the absence of horses, one important reason for the freedom from dust and dirt of the Exposition grounds is the thorough sprinkling which is kept up. Nowhere have we seen such excellent and systematic street sprinkling as is done on Chicago parks and boulevards; and the Exposition roadways are even better cared for than those outside, with the sole exception that the sprinkling is a trifle too free, so that it makes the walks a little muddy at times. The sprinkling is not confined to the roadways either; but the aisles in the interior of the buildings are all systematically sprinkled by hand carts. The advantages of this sprinkling are very great. No matter how many hurrying feet are crossing the plazas or passing down the aisles, no dust cloud follows them, while the water also sensibly cools the air. It is to be hoped that the managers of every following Exposition will take a hint in this matter from the experience at Jackson Park. The expense of sprinkling the aisles inside the buildings is very light. The sprinklers used consist merely of a kerosene barrel connected to a 4-ft. length of perforated pipe. One barrel full of water will sprinkle an area of nearly 15,000 sq. ft., and a man with such a sprinkler can cover 45,000 to 50,000 sq. ft. per hour.

In the matter of seats for the weary Chicago also leads. There was just complaint at first at the lack of free seats, but free chairs and settees have now been provided to meet this need reasonably well at various places about the grounds and buildings. But still more convenient than these are the little folding chairs, weighing not more than two or three pounds, which can be rented at the entrance for 10 cts. per day. The most unique and praiseworthy provision of all for the weary are the resting parlors provided at various places on the grounds by the Bureau of Public Comfort, furnished not only with easy chairs, but with lounges or cots, screens to secure a certain amount of privacy and attendants.

The state buildings are a provision of the same nature, and on a gigantic scale. They are one of the most charming and notable features of the Exposition, and as different in conception as they are superior in size and magnificence to those at Philadelphia. We shall describe these more particularly in another issue, as they well deserve. Of no feature of the Exposition have Americans more reason to be proud, since they are not only an evidence of material and artistic civilization, but of social civilization as well. In no other country could superbly furnished clubhouses, as numbers of them are, be thrown open to the free use of the miscellaneous crowds which visit such an Exposition without having the privilege greatly abused. At Chicago it is not abused at all, with exceptions too trifling to note. While the credit for these buildings belongs primarily to the several states, the "keynote" for them must have been struck by the Exposition management, and that this was so to some extent is conclusively shown by internal evidence.

The one feature in which Chicago is decidedly behind Philadelphia and all other prior exhibitions, is in its restaurant service. We have spoken of this before, and we do not wish to harp on it, especially as we are glad to learn there is some improvement; but the unwisdom of the management in neglecting this important detail is so great that it should at least be made clear. At every great exposition ample provision should be made for two great classes of visitors, which in an American crowd off pleasuring, are always about equal in number; first, for those who want luxurious comfort and are willing to pay for it; secondly, for those who want good, wholesome food served as economically as is consistent with good quality. At Philadelphia both of these classes were well provided for, and the nicer restaurants, especially, were unexceptionable. At Chicago, neither has been provided for. It is not possible to get a cheap lunch, however roughly served, and (with rare and scattered exceptions) it is not possible to get a well served lunch at any price. This is particularly unfortunate because the Chicago Exposition is open evenings, while the Philadelphia Exposition was not, and a special effort should have been made to make it the popular thing for parties to dine and spend the evening together on the grounds. Several instances are within our own knowledge where such parties were proposed, but abandoned on the sole ground that the restaurant service was at once so bad and so expensive that it would be a mere irritation to attempt anything of the kind. The result in each case was the loss of several dollars gate money. We have no doubt that the total loss of possible attendance from these causes will run up into the millions.

This was wholly unnecessary. There was room enough, and to spare, about the grounds and buildings, where arrangements could have been made to sell wholesome cold lunches with hot tea and coffee at a moderate price (say, 50 to 100% advance on the cheap business lunch places), and let the leg-weary visitors sit down while eating. Such places, had they existed, would have somewhat relieved the regular restaurants, and enabled them to collect as much or more money from a smaller number of more luxurious visitors. There are no such places on the grounds. The only thing at all approaching it are frequent booths of a concern styling itself the Wellington Catering Co., where the visitor is perched upon a stool in a foul ill-smelling room before an untidy counter and served with "sandwiches, 10 to 25 cts." (generally 15 to 20): the quality of the viands and the standard of neatness and appointments being decidedly inferior to those usually prevailing in the 5-ct. lunch places which abound in all our cities. Such places seem particularly incongruous with the surrounding architectural grandeurs.

The space and money devoted to the booths for selling Waukesha water alone would have gone a long way to have provided such additional facilities as we speak of, which brings us to another point of comparison between Chicago and Philadelphia, the drinking water. In final result Chicago has the best of it. The Philadelphia water was then and is now hardly fit for human use, with the result that the city has a chronic excess of typhoid fever deaths. But the water was free; it was cold, and it was abundant. The Chicago water is (we hope only temporarily) open to still greater suspicion for this cause, as is known the world over. Advantage was taken of these just fears by a speculative enterprise to cover the ground with booths for retailing "Pure Spring Water" at a cent a glass. At first it was intended to have this the only supply of drinking water on the grounds, but it was finally decided to have free sterilized water also on tap. As if to discourage the use of this free water, however, the tanks holding it are the only shabby and repellant things which the management has placed about the grounds. They are set low and rarely set straight; they are painted and lettered rudely with a "Sterilized water for drinking" sign on them; they have battered tin cups attached to them by heavy chains, and they are rarely anywhere near a "cent-a-glass" booth. The contrast is so very marked between them and everything else which the Exposition management has done that it is impossible to avoid a suspicion that the Waukesha company had some influence in designing them, for it would have cost practically nothing more to have had these water boxes neat and attractive, in keeping with everything else. A few Pasteur filter water cases have been added more recently which are in keeping with the surroundings, but until very recently at least these mostly stood empty, especially those near the Waukesha stands.

A matter in which the contrast between the expositions of 1876 and 1893 is decidedly favorable to the latter is in the water closets and toilet-rooms. At the Centennial, foul-smelling iron urinals, unroofed, but inclosed by fences, were scattered around in various parts of the grounds. At Chicago, every building has its toilet-rooms for both sexes, well ventilated and deodorized, and provided with abundant water supply. Those who object to the public closets are for a fee of 5 cts. admitted to the "pay" toilet-rooms, where, besides closets and urinals, washbasins, towels, etc., are provided.

On the whole, the Chicago Exposition shows a decided advance on Philadelphia in provisions for public comfort, as it does most conspicuously in every other respect; but it must be admitted that it shows a less advance in this respect than it does in its material and artistic features, which is not altogether as it should be; yet, such marvels have been accomplished at Chicago that it would be most unjust to blame the management for not having thought of every possibility.

We have noted above two or three respects in which further improvement is most needed, and it is intresting to surmise in what direction the next great step in advance will be made by the managers of future expositions. A hint in this direction is afforded, perhaps, by the Egyptian pavilion and electric scenic theatre, erected by the Western Electric Co., in the Electricity Building. Here are two rooms, each covering an area, perhaps, 25 ft. square. Visitors step into them from the sweltering heat outside, reaching, perhaps, 90° or more, and find themselves in an atmosphere of about 65°. From grated openings in the floor a strong current of cool air rises and keeps the rooms continually cool and fresh, no matter how hot the air outside. This cool air is drawn by fans from the electrical subways; but it is evident that it might as readily be secured by passing the inflowing air over the coils of a refrigerating machine.

Perhaps at the next great world's fair, we shall not see people trudging around with dripping brows and wilting collars. What could add more to the comfort of visitors and the attractiveness of a great exposition in midsummer than provision for cooling every building to a temperature of 75°?

The triple-screw protected cruiser "Columbia," the so-called "Pirate," is nearing completion at the Cramps' shipyard, in Philadelphia, and preparations for the trial trip are being made. The contract calls for 21,000 I. HP. and a speed of 21 knots maintained for four consecutive hours. The Cramps are confident of exceeding this requirement in the preliminary trial, which may take place on July 26, and naval men generally entertain great expectations as to the powers of this novel ship.

LETTERS TO THE EDITOR.

THE SAN BLAS CANAL PROJECT.

Sir: It astonished me to read an article in a late issue of your journal on the proposed San Blas route for an interoceanic canal. Last year I had occasion to spend several months in Berlin and a few other German cities. I became firmly convinced that the Nicaragua Canal is a practical and a comparatively easy engineering undertaking, and could be completed for less than $77.000,000, unless excessive "promotion" of interest charges may in the end be necessary. Even in this case $90,000,000 should build the Nicaragua Canal.

These conclusions on my part are but what I have absorbed from reading and collecting all matter possible for several years past bearing upon the Nicaragua and other proposed canals. But more especially was it apparent that the Nicaragua Canal is a practical route from the fact that eminent German engineers in open discussion were almost unanimous in favoring this route.

I never was, and am in no way, connected with the Nicaragua or any other canal project, and my only object is to state what is already well known to many, that the best German engineers regard the Nicaragua route as the only practical route for a ship canal across the Isthmus. I understood, moreover, that if funds cannot be obtained in America for constructing the canal that they cou'd be had in Germany.

Sincerely yours,
J. W. Howard, C. E.

Chicago, Ill., July 11, 1893.

ELECTRIC LOCOMOTIVES.

Sir: In your description of an electric locomotive in your issue of July 13, is it designed for a use of a trolley on the locomotive or is it for a storage battery? Yours respectfully, G. B. R.

Wilmette, Ill., July 19, 1893.

(The trolley rod is distinctly visible in the photographic view, on top of the cab.—Ed.)

FREIGHT TRAFFIC ON ELECTRIC RAILWAYS.

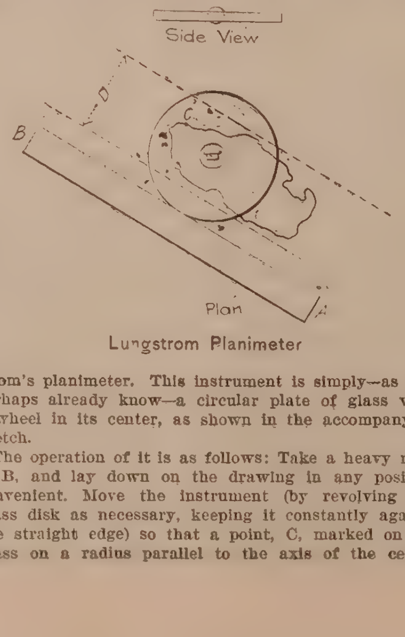
Sir: In the editorial notes in your issue of July 6 you suggest the desirability of having a light freight or baggage service on electric railways. A car intended for this purpose is in daily use on the Haverhill, Merrimac & Amesbury Street Railway between this city and Salisbury Beach, a distance of about 18 miles. This car is constructed like an ordinary box car, having a partition near the center of its length. The baggage portion has wide sliding doors on each side, the other portion being fitted up for passengers. The Danvers road, recently chartered, has a clause in its charter which permits an express or baggage business.

Very truly yours
John T. Desmond.

Haverhill, Mass., July 14, 1893.

THE NEW LUNGSTROM PLANIMETER.

Sir: Noting an article in your last issue about the use of planimeters in railway practice, I agree with your correspondent that engineers, and even architects sometimes, would find a more extensive use of these instruments of considerable advantage. I wish at the same time to call your attention to a planimeter almost more handy in use than the polar planimeter, and giving far better results. I mean Lungstrom's planimeter. This instrument is simply—as you perhaps already know—a circular plate of glass with a wheel in its center, as shown in the accompanying sketch.



Lungstrom Planimeter

The operation of it is as follows: Take a heavy rule, A B, and lay down on the drawing in any position convenient. Move the instrument (by revolving the glass disk as necessary, keeping it constantly against the straight edge) so that a point, C, marked on the glass on a radius parallel to the axis of the center wheel (at a distance from the center, depending on the scale used) will describe the outline of the area to be measured, and at the same time the edge of the glass plate never departs from the rule. The area is then indicated by a scale connected with the center wheel.

Yours truly, Eric Swensson.

Watseka, Ill., July 11, 1893.

(The planimeter described is an entire novelty to us, and we find on inquiry that it is also unknown to some of our leading dealers in such instruments. We judge from this fact and from our correspondent's letter that it is of very recent invention, and if sound in principle, as it doubtless is, it strikes us as likely to prove a decided advance for practical use, and it certainly is a scientific curiosity and novelty—the first decided deviation from the original Amsler planimeter, which has become known to us, though that instrument has been modified in its details in a multitude of ways. One obvious advantage of the disk planimeter is that it may easily be told in advance whether the instrument is so placed as to permit of measuring the whole of any given area at once. If the entire area falls within the strip DD it can all be measured; otherwise, not. We shall be obliged if our correspondent will procure for us a more complete description of this instrument.—Ed.)

ESTIMATE OF COST OF RAILWAY SERVICE.

Sir: In explanation of my estimate of comparative cost of railway service commented upon by you in the article on "Railway Management in India," in your issue of April 6, I beg to say that I take the cost of freight traffic in the following manner: In the year 1890 (the latest records we have) the Indian railways carried 22,612,718 tons of goods, and earned thereby $64,975,855, which is at the rate of $2.87 per ton per year. Dealing with English lines in the same way, the cost to the country comes out at 75 cts. per ton per year, and on the American lines a little over 25 cts. per ton per year. Mr. Jeans says it is next to impossible to get a good idea of the average haul or lead on any system of railways. I omitted the distance altogether, and made the comparison in the above way, as being fair all round, and fully confirming Mr. Jeans' statement that your lines had saved to the whole community in the cost of goods transportation upward of $500,000,000 a year by your superior management. The Indian lines are doing less and less work every year, and now they will not publish the quantities carried during the year, and the general complaint all around is that it is unprofitable almost to send goods by them, or you would be feeling their competition very keenly.

Yours very truly
Jno. F. Fischer.

Bangalore, India, May 30, 1893.

(Our correspondent has taken a method of comparison which is entirely defective in its omission of the all-important factor of distance, or length of haul, since in cost of service it makes a great difference whether a ton of freight is hauled one mile or 100 miles. The ton-mile is therefore the only correct basis of comparison, and the cost of service divided by the tonnage has no significance. In Mr. Dorsey's paper on "English and American Railways" (Transactions, Am. Soc. C. E., January, 1886), the figures for England and America are given for the year 1883, as in the following table, to which we have added the figures of the United States and India for 1891:

	1883.		1891.	
	U King.	U. S	U. S.	India.
Receipts per ton moved.....	$0 70	$1.373	$1.068	$2.00*
Freight charge pr. ton pr. mile	0.02	0.0124	0.0089	0.0138
Mileage per ton hauled	35 miles	110 miles	120 miles	162 miles

*Including general freight, military stores, coal and live stock.

The Indian railway administration report for 1891 was issued some months ago, and gives specifically the "average cost of hauling one ton of goods one mile" (in other words, the cost per ton-mile), and also gives the average passenger and freight haul. The Indian reports are very complete, but would be more readily available if a tabulated analysis and summary were given, as under the present arrangement each seeker after information has to wade through tables and pages of reading matter to find the averages, which are scattered through the several departments. English railway statistics are notoriously defective in their omission of the ton-mile, and they are little more than a mere mass of figures from which very little real comparative information can be obtained. —Ed.)

USING LEVELS OUT OF ADJUSTMENT.

Sir: In a discussion on the importance of the adjustment of the engineer's level with a few civil engineers, I stated that, though an instrument may not have all its adjustments perfect, yet correct work may be done with it. Some of my friends did not agree with me, and as there are possibly many who think as they do, and others who believe as I do, would you please, in the interest of "young men afraid of their instruments," say who is in error?

I stated that the only essential adjustment was the making of the line of sight parallel to the axis of the bubble. Of the other adjustments, the bringing of the bubble axis into the vertical plane through the telescope axis, and the making of the axis of the Y's perpendicular to the vertical axis, I claimed that the first of those two does not affect the work except the telescope is revolved from its true position, and that the latter adjustment is simply one of convenience in saving the trouble of releveling.

My friends also thought if an instrument be adjusted by the two-peg adjustment that it follows as a matter of fact that all the other adjustments must be perfect, and when I stated that if the telescope was revolved or reversed on its Y's after this two-peg adjustment, the bubble may leave the center of its tube, they said I was mistaken.

Again, in using the transit as a level, I held that no matter how great the error of collimation, it has no effect on the transit as a leveling instrument, and that the only important adjustment is the making of the axis of the telescope bubble parallel to the line of sight, which may be done by means of the two-peg adjustment. Joseph P. Egan.

(The level as a theoretical instrument, and also in good practice, consists only of its telescope and attached level. All else is functionally a part of the tripod. It is, of course, sufficient for good work to have the bubble and telescope parallel. Good levelers have the other adjustments in good order for convenience, but never trust to them, readjusting the bubble just before a final sight, even if the telescope has not been moved, and still more if it has. It should not be possible for intelligent young men to dispute over such a point with elementary textbooks at hand. The other questions will all be found answered in them.—Ed.)

RESPONSIBILITY FOR THE FIRE AT THE WORLD'S COLUMBIAN EXPOSITION.

Sir: A press dispatch of to-day entitled "Held for Criminal Trial," gives such a striking instance of the proverbial injustice done to engineers by executive officers, and through them by the press and public, that we instinctively turn to the professional press to remedy by agitation such palpable unfairness.

Perhaps no one, not of the profession, whether visiting the Exposition or not, has been permitted to appreciate the part played by engineers in this stupendous enterprise, nor the great responsibility which they successfully and faithfully discharged. Even in a trip to the Exposition the visitor learns only of the achievements of the "managers" in praise of which the services of the engineer are ignored and his well deserved credit stolen. But let there be an accident or a calamity such as the burning of the Cold Storage Building and how quickly do these high officials, who have taken to themselves the credit for all things, shield themselves behind the heretofore forgotten engineer.

It is time that the public should know the facts, that criticism be directed against those who have absorbed all praise, and that the engineer be made no longer the scapegoat of all high-salaried public officials of supposed "executive ability" and autocratic powers. Geo. A. Just.

New York, N. Y., July 19, 1893.

(The burning of the Cold Storage Building at the World's Columbian Exposition was described in our issues of July 6 and 13, and certainly the Exposition management is to blame in permitting such reckless construction as that which led to the terrible disaster. They cannot disclaim responsibility merely by saying that when the concession was let they had nothing to do with the construction. The investigation which this disaster led to show that there were other cases where there were chances for serious accidents. The significant part of the press dispatch to which our correspondent refers, we reprint below:

Chicago, Ill., July, 18, 1893.—After its prolonged investigation the coroner's jury investigating the World's Fair Cold Storage calamity, reached a verdict at 5:30 this evening. The jury held up to the Grand Jury the following persons: Burnham, D. H., Director of Works, the World's Fair; McDonald, Charles A., Secretary and Treasurer of the Hercules Iron Company; Murphy, Edward, Fire Marshal of the World's Fair Fire Department; Skinner, J. B., President of the Hercules Iron Company. The verdict was the same in all the cases, and read as follows:

> We, the jury, find that the deceased came to their deaths from injuries and burns received at a fire of the Cold Storage Building at the World's Fair grounds on July 10, 1893, and we, the jury, find from the evidence presented that Charles A. McDonald, John B. Skinner, D. H. Burnham and Edward W. Murphy be held to the Grand Jury for criminal negligence and there held until discharged by the course of law.

The indicted men will be in court at 10 o'clock tomorrow morning. Director of Works Burnham said to-night: "This is a great surprise to me. I was never officially notified of the unsafe condition of the cold storage tower, and Engineer Shankland never reported the tower as dangerous."

Mr. E. C. Shankland, upon whom the blame is sought to be indirectly thrown, is Chief Engineer of the Exposition, and designed the magnificant 368-ft. arch trusses of the Manufactures Building, the largest in the world (Eng. News, July 28 and Sept. 1, 1892), as well as much of the bold structural iron-work of the other main buildings. The public read of, see and appreciate the successful and beautiful work of the architects of the buildings, but they do not understand or appreciate the boldness and grace of the steel structures of which the architect's work is but the clothing, nor can they realize the work and responsibility involved in the design of steel framework on such an immense scale. The chief engineer is the designer and the head of the construction department, but it is not his duty as chief engineer to inspect and supervise the carrying out of every detail, while it is the personal duty of a "Director of Works" to see that all works are carried out as well as designed safely. It would be impossible for the chief engineer as such to do this, and it is not right or just to seek to throw upon him the responsibility for the terrible accident. The design as approved provided for certain safeguards, which in construction were omitted, as shown in our issue of July 13. The responsibility rightly rests upon the owners of the building, and the fire department officials and the building inspectors for permitting such construction, and upon the Exposition management for not taking greater care to insure safety by proper and systematic inspection. It might have been foreseen as certain that mere money-seekers like most of the concessionaires, would transgress sound rules of construction to save money or even to save trouble only.—Ed.)

EMPIRICAL FORMULAS FOR ESTIMATING COST OF PIPE-SEWER WORK.

Sir: For some time past I have watched with interest certain quotations given in Engineering News under the head "Current Prices for Contractors' Materials." The information to be obtained from the compilation is quite valuable. Time and again I have tried to get at the proper amount, or percentage of total outlay, that should be set aside for the purchase of tools, when making calculations for bids for laying pipe sewers. Unless a person is thoroughly familiar with prices of supplies it is impossible to get a fair figure for such estimates. Another quantity I sought was the cost per man—in tools, wages, and for superintendence. By means of your table and my knowledge of the wages of men in my charge, I built up an empirical formula that I find very useful in quick estimates. Thinking perhaps it may be of interest to some of your readers I give it to you for what it is worth.

Making calculations with a block of 50 men, taking current prices for materials, $4.60 per man is the average first cost for a kit. This kit includes the requisite number of implements to carry on the work under the most favorable conditions. Wages varying in different sections, I give figures for the Northern and Southern States. In the Northern States the working day is ordinarily 9 hours long, and prices paid range from $1.50 per day for common laborers, to $3.50 per day for foremen. An examination of my record for sewer construction shows $81 per day to cover the wages of the block, plus the cost of superintendence

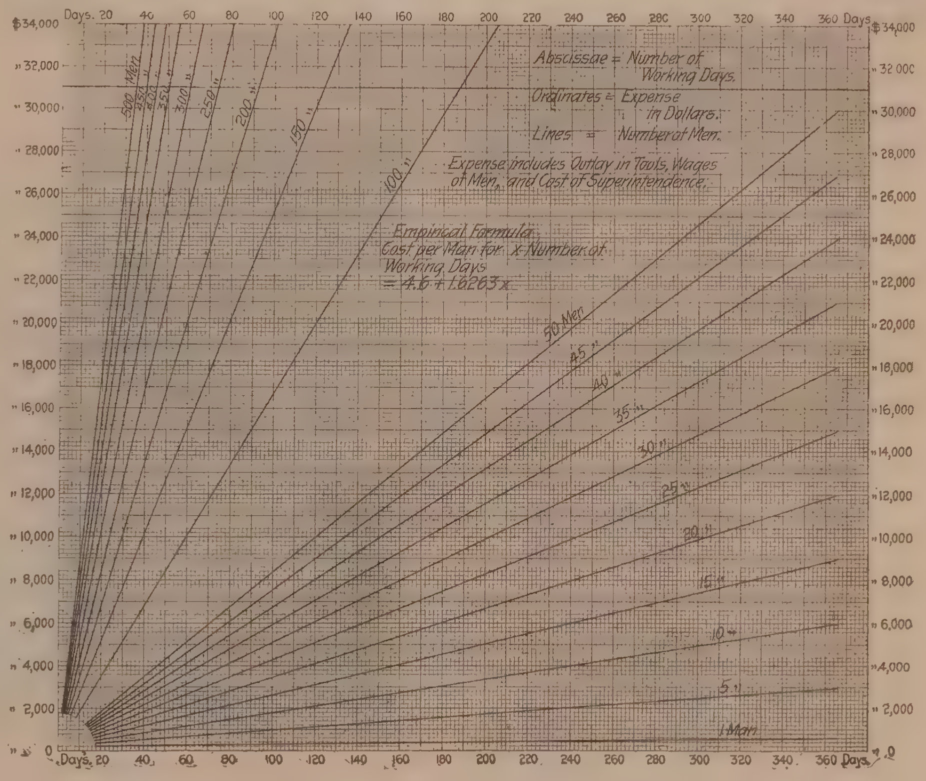


DIAGRAM OF FORMULAS FOR ESTIMATING COST OF PIPE SEWER WORK.

Then, allowing for an entire new outfit every two years, when x equals the number of working days:

$$4.6+\frac{x}{50}\left(\frac{115}{365}+81\right)=$$

4.6 + 1.6263 x = cost, in dollars, per man for x number of working days. No change in the formula is required for a year of 366 days. In the Southern States 10 to 12 hours constitutes a working day, and prices range from 75 cts. per day for common laborers to $2.25 for foremen. Calculating as above, the cost per gang of 50 men averages $47 per day.

Then, as above, we have

$$4.6+\frac{x}{50}\left(\frac{115}{365}+47\right)=$$

4.6 + .9463 x = cost, in dollars, per man for x number of working days.

It is to be noted that these formulas take in three items only—necessary tools, wages of the men, and cost of superintendence; it does not deal with teaming, lumber for shoring, etc.

As a quick means of getting at any desired result I have plotted a rough diagram, a blueprint of which I send you, based upon the first of the above formulas, i. e., that for the Northern States. This diagram, resembling railway earthwork diagrams, explains itself.

Very respectfully, J. G. Barzl.

Wilmington, N. C., July 5, 1893.

EFFECT OF OILS ON METALS.

Sir: I inclose an extract from a portion of the graduation thesis of Mr. Wm. Marcy, of this year's class. Possibly the results, showing action of oil on copper and iron, may be of interest to you.
and iron, may be of interest to you. Yours truly,

William P. Mason.

Rens. Pol. Inst., Troy, N. Y., June 7, 1893.

(The table is as follows, from which it will be seen that, if these tests may be regarded as conclusive, that there are notable differences in the effect of oils on metals. The experiments seem to us to be quite too small a scale to be decisive, however.—Ed)

Results of the Exposure of Copper and Iron in the Different Oils for a Period of Ten (10) Days at Ordinary Temperature.

Oils in which exposed.	Copper.			Iron.		
	Wt. 1st gms.	Wt. 2d gms.	Loss gms.	Wt. 1st gms.	Wt. 2d gms.	Loss gms.
Almond	1.9157	1.9136	.0021	2.2560	2.2556	.0004
Olive	1 3798	1.3778	.0020	2.1830	2.1805	.0025
Castor	2.0232	2.0232	.0000	2.7051	2.7047	.0007
Sperm	2 0068	2.0068	.0000	2.2788	2.2776	.0012
Lard	1.0138	1.0132	.0006	2.2645	2.2640	.0005
Paraffine	0.8462	0.8456	.0006	2.2288	2.2285	.0000
Linseed	1.0083	1.0078	.0008	2.2738	2.2733	.0010
Rapeseed	1.6125	1.6123	.0002	2.5180	2.5180	.0003
Cottonseed	0.8964	0.8913	.0051	2.7205	2.7196	.0001
Neatsfoot	0.9293	0.9283	.0013	2.2096	2.2085	.0010

THE CATTLE-GUARD PROBLEM.*

The cattle-guard is essentially a fencing device, its application to the track being only designed to effectually preserve the continuity of the fences across the tracks, which must be kept open for the passage of trains.

It will not be claimed that such guards can do more than stop or deter under ordinary conditions, and but little provision can be made to absolutely insure protection of children, persons of unsound mind, or famished and incorrigible animals. The responsibility for the care of these should surely be imposed upon the parent or guardian in the one case or upon the stock owner in the other.

Not only will certain stock cross over cattle-guards. but the standard fences prove inadequate barriers against occasional unruly animals. Say that two-thirds of our railways are fenced, then to provide for the exceptional cases mentioned, by increasing the height of the fences one foot, would require over 585,000,000 ft. of fencing lumber, 265,000,000 lin. ft. of posts, and nearly 4,000 tons of nails, at an enormous cost, and still the fences would not be secure against all.

It is self-evident that an unobstructed way is essential to a proper use of the track, for which reason cattle-guard devices have generally been formed so as to stop or deter animals by the insecurity of footing allowed by the device.

There is but little danger to a train moving at high speed striking standing stock, for the force of the blow and the lines of the pilot throw the animals clear of the rails; at low speed the animal is apt to be crowded down and the train derailed. It is in consideration of this element of danger that the engineman, when he finds the distance inadequate to complete a stop, will give his engine more steam, so as to strike the animals while running at high speed. To strike one or more animals lying on the track is attended with considerable danger, and derailment of the train is apt to follow.

These facts have an important bearing on the design of cattle-guards, and compel a form of construction which will not entrap or catch the animal's foot; for when so caught, it is generally thrown to the ground, or will finally lie down from exhaustion after repeated efforts to free itself. It is evident, then, that when an unruly animal, in spite of pain and difficulty, persists in crossing or leaping a guard, the safety of trains requires that the attempt be successful, for to entrap the animals would probably result in serious disaster.

In early days when motive power was light, trains infrequent and run at moderate speed, within easy control of the trainmen, the open pit-guard could be tolerated, but the danger of their engulfing a train having a derailed truck, a not infrequent mishap, soon led to the use of chamfered ties for a deck. But if the ties of a covered cattle-guard are arranged to afford the best design of bridge floor for the passage of trains, ample and sure footing is accorded the animal which attempts to cross it, and it totally fails as a cattle-guard, whereas, to perfect it as a cattle-stop introduces forms of construction which presents elements of danger to trains.

These considerations led to the use of a surface wooden guard, which minimized the disturbance to track conditions and was expected to prove reasonably effective as a cattle-stop, and be also inexpensive. As this guard however only afforded inconvenience of footing to animals attempting to cross it, they soon became familiar with it, and in the main, it has been discarded, except at points where the infrequency of roving stock makes cattle-guards largely a matter of form.

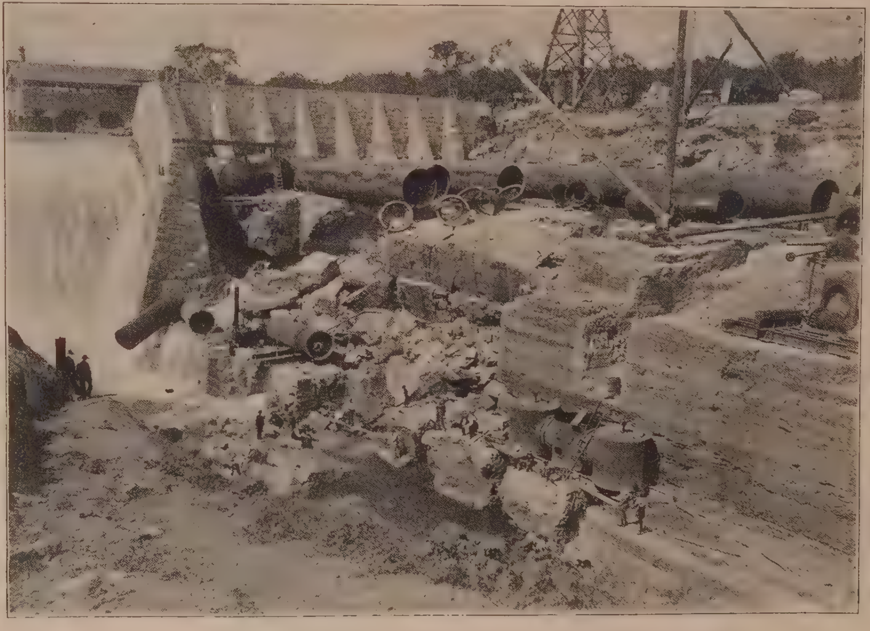
In recent years the metal surface guards have been very generally used, and while not absolute cattle-stops, some forms have proved very effective in deterring animals under ordinary conditions. Those forms which have simply depended upon their unfamiliar appearance to deter, or inconvenience of footing to restrain, have proved of little value, as in a little time both are overcome and the effectiveness of the guard is lost; but those guards which have been designed to pain without permanently injuring the animal, have succeeded in stopping all but the famished or incorrigible few. Every attempt of the animal to cross should be attended with pain, so that familiarity increases instead of lessens the deterring influence of the guard.

But in presenting a form of cattle-guard which will inflict pain upon the animal, another problem presents itself, for it must be so constructed as to present no projecting points, such as would catch the hanging chains or rods of a moving train, tearing up the guard and introducing new forms of danger. This important feature has greatly modified existing forms of guards, and must continue to be recognized.

Cattle-guards constructed upon the principle above outlined have by experience proved to be effective cattle-stops; while they introduce no features in the track tending to the discomfort of passengers or danger to trains, the only menace to safety being the few incorrigible animals which can be neither restrained nor deterred by appliances which meet the mechanical requirements of advanced railroading. Surely the owners should be obliged to care for such unruly animals so as to remove them from this source of danger, and conserve the safety of the traveling public.

---

*Extracts from a forthcoming pamphlet with the above title, by Benjamin Reece, M. Am. Soc. C. E., containing the laws of the different states concerning cattle-guards and railway fences, with a digest of important judicial decisions. The Q. & C. Co., Chicago, publishers.



BREAK IN THE COLORADO RIVER DAM AT AUSTIN, TEXAS.

THE BREAK IN THE AUSTIN DAM, TEXAS.

In connection with the late accounts of the break in the Austin dam, a photograph is here presented showing the situation at a late date. Referring to the letter of Mr. J. F. Fanning, the consulting engineer, in our issue of June 29, it appears that this break was in the bank near the easterly end of the headgates of the new dam. The water escaped through a crevice in the stratum upon which the headgates rest, which crevice extends east of the gates and meets a seam in the rock nearly at right angles to it and passing diagonally toward the power-house. The excavation for the head of the canal, at a point about 100 ft. above the gates, came very near to this crevice, so near in fact, that the water gradually found its way into it and enlarged it in a soft stratum of rock until the bank finally settled and with it went the easterly end of the headgate masonry. At the present time a cofferdam is being completed for the purpose of laying bare the area affected, and Mr. Fanning expects that by trenching across the crevice and by putting in a masonry stop-wall the trouble can be remedied. The photograph shows the cracks in the masonry, and also plainly indicates the somewhat uncertain quality of the stratified rock upon which this work is founded.

Meanwhile, according to Austin papers received, this unfortunate dam is now having trouble of another sort. Mr. E. W. Groves, for three years past connected with this dam, and lately the engineer in charge of repairs, has resigned, and his resignation has been accepted by the board. In his letter of resignation he briefly states his reasons, os follows: Constant interference with the engineering work by Mr. John McDonald, Mayor of Austin and President of the Board of Public Works; and further, that the fact that Mr. McDonald was largely interested in boats prevented the engineer from drawing down the water in the dam, and thus making more certain and easy the dangerous work of repairs on the dam. Mr. McDonald, on his part, in a letter to the board, claims that Mr. Groves "has neither the skill nor the executive ability to conduct the work properly," and he is satisfied "that he will not be guided by advice and will not listen to reason." Engineers will have little difficulty in accounting for Mr. Groves' resignation under these circumstances, as the experience unfortunately is not rare. As far as can be learned, Mr. McDonald is simply "a practical man" without technical education; but he has authority and seemingly proposes to use it in the construction of this important engineering work regardless of consequences or any interests other than his own. He may be honest enough in his intentions, but judging from the past history of this work, engineering and personal, he lacks what is very essential even in a practical man—and that is common-sense.

WHO SHALL JUDGE OF THE SANITARY QUALITY OF A WATER SUPPLY?*

By Prof. T. M. Drown.

What constitutes a pure water supply and who shall be the judge of its purity? Shall it be the physician, the chemist or the biologist?

A man naturally goes to his doctor in matters pertaining to health, but I must confess that I often get out of patience with the doctors when they talk about the effect of drinking water on the health of a community. I have in mind a case where a suit was brought for damages against a landlord because the doctor attributed the sickness of several members of the household to the impure water of the well, and the cases of sickness included rheumatism, nervous prostration, eczema and general debility. A very potent water surely, was this.

---

*Abstract of the remarks at the meeting of the Connecticut Society of Civil Engineers and Surveyors in New Britain, May 31, 1893.

What I object to is the positive condemnation of a water supply as a source of danger on insufficient grounds, or no grounds whatever, thereby causing needless alarm and doing great injustice to water commissioners or superintendents who may be zealous in preserving the purity of the water.

A doctor who will talk learnedly of the "self-purification of streams" and of the "necessity of aeration" from books of the last generation, and will attribute diseased conditions of a community to the failure of certain necessary conditions in a water supply is difficult to deal with.

It may not be uninteresting to consider for a moment the chemist's position with regard to the composition of drinking water. When a sample of water is sent to a chemist for analysis he is generally requested to ascertain whether there is anything in the water which would prove injurious to health, on the presumption that he tests for known injurious substances as he would test for poisons—arsenic, mercury, or strychnia, for instance. In reality he does nothing of the kind. He determines, mainly by indirect means, the amount of organic matter a water contains, and the products of the decomposition of this organic matter. When he has obtained his results they are of no value until they are interpreted. Our methods of water analysis come to us mainly from England, where also certain "standards of purity" have been established by sanitary authorities from time to time, by which the purity of a water or its fitness for drinking is judged. These standards are entirely arbitrary, but they make it easy for the chemist to give an opinion on a water, for he has only to compare his results with the standards and approve or condemn the water accordingly.

These standards were undoubtedly a step forward in the sanitary examination of water, and may have served in their time a good purpose, but since the germ theory of disease has obtained general acceptance they have become worse than useless. Yet so convenient is it for an analyst to fall back on authority in matters of sanitation that the average chemist gives up these standards only with great reluctance, for without the means of interpretation his analysis is useless. Not long since a case came under my notice where a brown, swampy water, from an uninhabited area was condemned by a chemist as polluted, because its albuminoid ammonia was above the standard.

Surely the bacteriologist and biologist ought to be able to tell us whether or not a water is fit to drink. Some of them are certainly very confident of their ability to do so. I have a case in mind in a neighboring state, in which a bacteriologist was asked to give an opinion on a surface water supply because of its bad odor. A sample of water was sent to him for examination, and he reported that the water was seriously contaminated by sewage, and he recommended that a careful inspection of the watershed be made to discover the source of pollution. I can imagine the surprise and indignation of the superintendent of this water supply at receiving such a report. He, of course, knew every square foot of his watershed, which at most had only about a dozen houses, none of which drained directly in the stream or reservoir.

I do not wish by anything I have said to bring contempt on the sanitary examination of water, or on the physician, chemist, or biologist, who is studying the matter of watter supply in a truly scientific spirit. There has been great progress made in the last five or six years in our knowledge of the chemistry and biology of water supplies. Our methods of investigation are better, and our interpretation of results is based no longer on arbitrary standards, but on a vast amount of accumulated knowledge of the relation which chemical results bear to the origin and environment of the water. When we know that an unpleasant taste or odor in the water is due to diatoms, for instance, we give ourselves no anxiety, for we have no reason for thinking that the minute vegetable organisms, which are present in almost all surface waters, are in the least injurious to health. On the other hand, chemical and biological investigations can often guard us against drinking bright, sparkling and good-tasting water, which may be injuriously contaminated with sewage. But laboratory analysis of water, be it chemical or biological, will seldom suffice for a clear understanding of the permanent character of a water supply. This is a question which should have the joint attention of the engineer, chemist and biologist, or, if you please, of the fully equipped sanitary engineer. And it were much to be desired, also, that the physician should be included in this list of experts on water supply, for no one is more than he immediately concerned in the healthfulness of a community.

I may, perhaps, be permitted to say that I think the merit of the work which we have been doing in Massachusetts in the matter of its water supplies and rivers, is largely due, I might say almost entirely due, to this happy co-operation of the engineer, chemist and biologist, learning from one another and helping one another.

CARRYNG A LOCOMOTIVE ACROSS COUNTRY.

Mr. T. C. De Land, of the Examining Board of the Treasury, is responsible for the following story, according to the Washington "Post," which if not true is at any rate well invented. We forbear to make prior inquiries as to its truth, as we fear if we did we should never have a chance to publish the story:

"The most successful and at the same time most unique civil service examination I know of occurred during the war," said Mr. De Land. "The Confederacy was very much in need of a railway locomotive in order to operate its supply system. It was in 1861 and it had not the means to buy an engine, so the invariable alternative arose—steal one.

"A band of 100 men was selected from Lee's army and placed under the command of a big six-foot-four Georgian, who had been foreman of a stone quarry and was more or less skilled in the use of derricks, etc.

"He took his men up into Maryland and they tore up a section of the Baltimore & Ohio railway tracks, flagged the next train, and with nothing on earth save plenty of rope those hundred men carried the locomotive 52 miles over hills, across streams, through bogs and woods until they struck a line the Confederacy had built. Then they ran the engine down to Virginia.

"When Robert Garrett, then president of the Baltimore & Ohio, heard of the feat, he couldn't believe it. He went out and personally inspected the scene; went over the route and declared it the most wonderful feat of engineering ever accomplished.

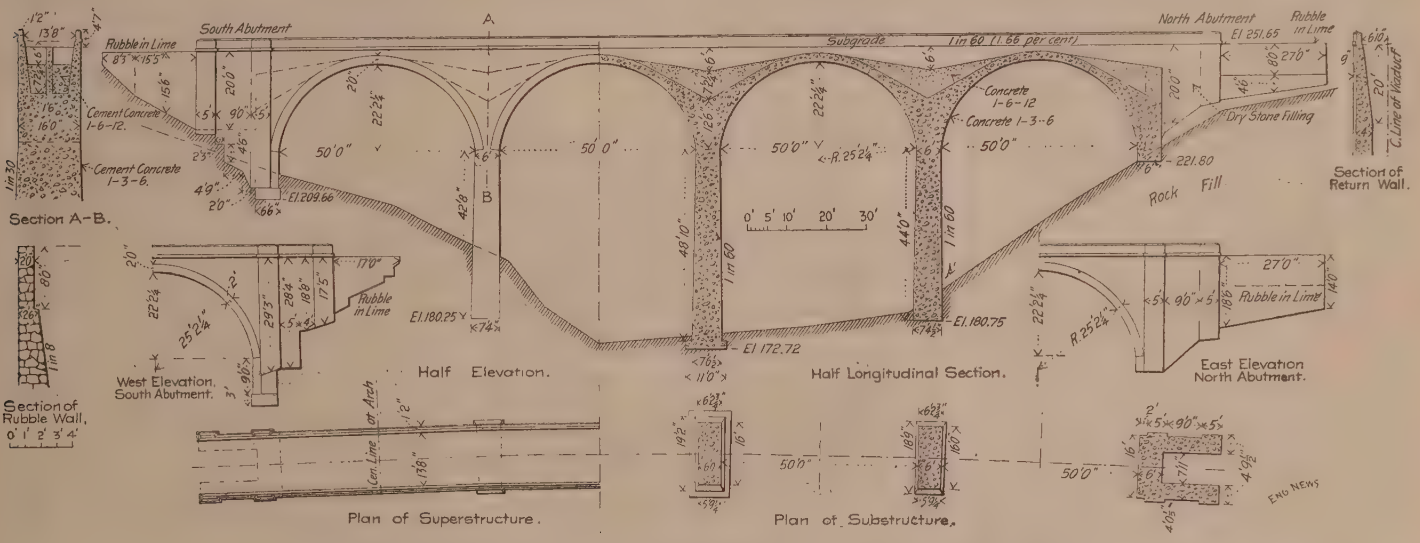
"After the war he delegated a man to find the leader of the band. He was located in Georgia. Garrett sent for him, and on the strength of that single feat, made him roadmaster of his entire system of railroads.

" 'Any man that can pick up an engine with fishing lines and carry it over a mountain has passed his examination with me,' he said."

VIADUCT IN PORTLAND CEMENT CONCRETE, JAMAICA RAILWAY.

Large masonry structures built solely of concrete are even now the rare exception. In 1881, when the structure herewith illustrated was built, it was the largest and almost the only considerable concrete structure in the world. It is still among the largest, if not the largest. It will be seen at the first glance to be of somewhat bold construction, but nevertheless it still stands without crack or blemish in 1893, and gives promise of indefinitely longer life. As the structure has never been illustrated before it seems desirable that its existence and proportions should be made of record, though it is hardly "news" to describe a structure which is already 12 years old. It is also of special interest, however, as a very bold structure as well as a novel one in its materials. It illustrates practically what has often been claimed and as often denied, that a well built concrete structure is practically monolithic, and will in fact permit of bolder proportions than are expedient with the best laid masonry arches.

The structure illustrated is one of three viaducts on the Ewarton branch of the Jamaica Government Railway, as it then was. It has since been transferred to a private American company, and is known simply as the Jamaica Railway. The other two viaducts are similar in design, but have five arches each instead of four, and are not quite so high from the ground. All are still in good order and in daily service.



VIADUCT OF PORTLAND CEMENT CONCRETE, JAMAICA RAILWAY; WEST INDIES.

The piers of this viaduct were built up to the level of the springing of the arches by making a casing of concrete blocks 18 ins. long by 9 ins. wide and 9 ins. thick, laid alternate headers and stretchers, and filling in between them with cement concrete, leveling up every course as laid. The arches, spandrels and piers above the springing line, up to an angle of 60° with the horizon, were built of concrete in mass. The central portions of the arches were built in cast concrete voussoirs, set in cement mortar 1 to 2, except that the keystone was of concrete in mass. All the concrete was of the proportions of 1 of Portland cement, 3 of sand and 6 of broken limestone. It was prepared by making mortar of the cement and sand, and then mixing in the broken stone. It was all hand mixed, 1 cu. yd. in each batch, and then gently deposited in position by small boxes, and not afterward disturbed, beyond setting the mortar against the boxing so as to make a good face. The intestices between the blocks were filled with mortar, the cement in the conglomerate being in the proportion of 1 to 6.

This viaduct was commenced in August, 1881, and completed in March, 1882. The centers were not slackened until 14 days after the last arch was keyed. The bridge is on a slight curve (1,980 ft. radius), the arches being truly cylindrical, and the piers trapezoidal with faces paralleled with the axes of the arches on each side.

These three viaducts, with some other large concrete works on the same line, were designed by and built under the direction of Mr. Valentine G. Bell, M. Inst. C. E., then Chief Resident Engineer of the Jamaica Government Railway, and now and for some years past Director of Public Works for the colony of Jamaica. In this last position, we may add, Mr. Bell has especially distinguished himself by his administration of the road system of that colony, which is one of quite unique excellence, both in methods and results. As such it will be more fully described in these columns shortly, as it may be studied and imitated with great advantage by every one of our states, since every one of them is far behind this "sugary, niggery little island" in this important index of civilization.

ADVANCE IN THE DESIGN OF BRIDGE SUPERSTRUCTURE.

In a paper upon bridge construction, lately presented to the Association of Civil Engineers, Cornell University, by Mr. George S. Morison, that skilled bridge designer speaks of the marked advance in late years in the design of bridge superstructure. Mr. Morison is so eminently able to discuss this subject that we give his many valuable hints and suggestions in his own words, as follows:

At the present day the superstructures of bridges of magnitude are almost always made of iron or steel. Perhaps it would be more proper to say, are always of iron, since steel is only a third form of iron intermediate between cast and wrought iron; or, more properly, iron manufactured in a peculiar way is called steel. The manufacture of cheap iron is a comparatively new thing. A century ago iron was not available for bridge superstructures. The bridge itself was made entirely of masonry or largely of timber.

The best way to understand modern bridge superstructure is to study its development. This development has taken place simultaneously in Europe and in America, but on very different lines in the two continents. The development of the European bridge was from a masonry structure to a metallic structure. The development of the American bridge was from a wooden structure to a metallic structure. This was the real order of development, though there have been in Europe many noted wooden bridges and there are in America old stone structures resembling those of Europe.

In America, for the first time in the history of the world, a people possessed of modern tools have had at their disposal ancient forests. The steam engine and the sawmill have made cheap timber from the forests which in other parts of the world were removed and worked up in early times by slow manual labor. The American builder had at his disposal the most convenient building material ever known. In white pine he had a material five times as strong as ordinary stone and weighing only one-fifth as much. The same timber is one-twelfth as strong as wrought iron and weighs only one-fifteenth as much. For immediate results nothing equal to it has ever been known. It has, however, three very serious defects. It is very short lived: if exposed to both air and water it may become worthless in less than ten years. It is very combustible. No additions can ever be made to the original stick and if it is to be used in tension there is a great waste in making proper connections. Its price measured by the unit of strain was formerly hardly more than one-twentieth the cost of iron. The cost of frequent renewals of timber was less than the interest on the additional cost of iron. A structure built of timber, after charging up the cost of renewals and allowing a liberal premium for insurance against fire, was still able to earn more money than an iron structure could after deducting interest on the additional cost. In other words, the wooden structure was the most profitable tool. Fifty years ago it was good engineering to build wooden superstructures, and it would have been bad engineering to build iron superstructures. Wooden superstructures were universally built. In many parts of the country bridges were built almost entirely of wood; the piers which carried the wooden superstructures were timber cribs filled with rubble stone. In fact, wood was wisely used in ways which at the present day would seem absurd.

Iron bridge building in America really began about 40 years ago, though it amounted to little till after the war. It started on two independent lines, one in the North and one in the South. The real pioneer of iron bridge building in the North was Mr. Squire Whipple. Mr. Albert Fink, then a young engineer on the Baltimore & Ohio R. R., really started it in the South. Both men used skeleton structures and calculated strain sheets much as is done now. The earlier iron bridges built in the North were really adaptations of the old wooden bridges made in iron. Cast iron columns were used for compression members; wrought iron bars for tension members. The top chord was always to be in compression. The bottom chord was always to be in tension.

The Southern development was of a different kind. It began by substituting iron for wood in some of the tension members; but instead of following the lines of the older bridges, and using iron only for the web members, it followed the lines of the trussed girder and built up long spans of combinations of trussed girders. By placing two trussed girders end to end, putting a post under the point of contact and running rods from the foot of this post to the outer ends of the beams the length was doubled and the unsupported length of beam remained constant. This system of construction could be extended indefinitely. In the earlier bridges of this class the compression members were always of wood. In the older all-iron Fink bridges, cast iron was substituted for timber, the tension members remaining as before. Another adaptation of the trussed girder made the two arms unequal, and, by combining the beams of a number of trussed girders with unequally spaced posts, formed the Bollman bridge. Twenty-five years ago this was a favorite form of iron bridge. Within 20 years it was universally used on the Baltimore & Ohio R. R.

After the war, iron superstructures began to increase and the Southern and Northern developments met. In both North and South cast iron was generally used for compression members and wrought iron for tension members. The tension connections were generally made with pins, but sometimes with screws. The compression connections were square butt bearings.

There was, however, one exception to this general rule. On the line of the New York Central R. R. riveted lattice bridges, perhaps a higher development of the Towne lattice, but more likely copied from European structures, were used. The first considerable number of field riveted structures were built upon this railroad.

The next step was the substitution of wrought iron for cast iron in compression members. It came first in the long web members and followed in the shorter members of the chords, but cast iron details continued to be used at the joints. It was at this time considered important to avoid anything like indirect strains. A bridge should be so designed that the strain could be transmitted to each member directly on the line of the axis of that member. About 25 years ago Mr. S. S. Post, a very careful and accomplished engineer, designed and patented the Post truss. It was based on theoretical considerations. It is generally known through the peculiar arrangement of the web, but Mr. Post laid special weight on the details. All connections both at top and bottom were made on pins, the only exception being that the several successive panel lengths of top chord butted against each other. The floor beams were hung from the panel points by double loop hangers passing arou[illegible] chord pins and around pins in the floor beams at right angles to the chord pins. It was admirably designed to relieve the structure of all strains tending to deform a member, but the stiffness of connections was sacrificed, and it would now be considered a very loose structure. Another feature that characterized the designs of that time was that they were erected without field riveting. The pieces as they came from the shop had simply to be fitted together and screwed up, and the work was done.

With the substitution of wrought iron for cast iron in compression members, it becomes evident that cast iron was out of place even in the details of the connections and that the bugbear of field riveting was imaginary rather than real. The cast iron joint box first disappeared in the bottom chord, then in the top chord and finally from the top and bottom of the end posts. When the fear of field riveting was removed the advantages of riveted connections for floor systems soon appeared. Until about 1873 wooden stringers were generally used on iron bridges. With riveted connections iron stringers came into use and panel lengths increased.

About 15 years ago, what is now the general American practice was practically established. Cast iron had disappeared from all truss members. Riveted connections in top chords and floor systems were generally preferred. The Pratt truss or the iron bridge with vertical posts was commonly used and the importance of stiff connections and rigidity as compared with theoretical lines of strain and flexibility was recognized. Since that time the changes have been rather in the direction of improvement of details, in increased loads provided for, in better material and workmanship and in reduction of strains, than in radical changes of structure. The bridge of to-day is simply the development of the bridge of 1878. The approved practice of 1893 makes bridge superstructures entirely of wrought iron or steel, and they are generally rigid structures with little vibration either in the whole structure or the details. The noisy rattle which was very common 20 years ago is seldom heard now.

For short spans, plate girders are generally used, and the length of this class of structure, which was formerly limited to about 40 ft., has gradually increased to 100 ft., and will probably go higher as soon as the rolling mills can furnish web plates for longer structures. A few longer spans have already been built and shipped in single lengths from the shops. In many places skeleton riveted structures are preferred for bridges of from 50 to 150 ft. spans. They are commonly called lattice bridges, but the name is not strictly correct.

For long spans, pin-connected trusses, very different in all other details from the pin-connected bridges of 20 years ago, are the general American practice. It is to the principles which should govern the designing of these bridges that I would next call your attention. In the first place, it must be remembered that while the superstructure rests on the substructure they are very different forms of construction. The substructure is supposed to be perfectly fixed and practically unaffected by either temperature or strain, and while this is not strictly true it is practically so. On the other hand, the superstructure is made of a material which is constantly changing its dimensions. Every change of temperature changes lengths. Every increase of strain does this also. The superstructure and substructure do not work together. Each must be made as nearly as possible independent of the other.

To secure the maximum of stability with a minimum disturbance the superstructure should be made as complete as possible in itself. It should not depend on the masonry substructure to hold itself together. In a deck bridge it is possible to put in transverse bracing to the full depth of the trusses. In a through bridge this cannot be done, but nearly the same results can be accomplished by making a deep rigid connection between the floor system and the posts of the web and by strong stiff cross frames occupying all available depth below the top chord. In other words, the posts of the two opposite trusses should be so combined that the two together shall form as nearly as possible a single member. This provision should not be confined to the intermediate posts of the truss. It is specially important that the same arrangements should be made at the ends. Where inclined posts are used this is somewhat difficult, but it can be done and the best possible result is obtained by using a rigid portal overhead and by making a rigid connection between the end floor beam and the posts. The old practice of omitting the end floor beam and letting the end stringers rest on the masonry is a very vicious one.

Another thing to be remembered is that the lateral system must have something to pull against. In light bridges it is very easy by overstraining the laterals to produce compression in the bottom chord. In all bridges the end panels of the bottom chord and in light bridges the entire bottom chord should be made stiff throughout. This also forms a great protection if, in case of derailment, the end post is struck. The independence of the superstructure also requires that it should rest on the masonry in such a way that changes of dimension can be taken up by free movement and that there will be no undue strains. This matter has not yet received the attention it deserves. While it is almost the universal practice to put one end of an iron bridge on roller bearings, it is usually done in so careless a way as to be virtually useless.

Formerly the end posts of bridges were finished with full bearings which rested at one end directly on the masonry and at the other on a nest of expansion rollers. No provision except accuracy of workmanship, and this often inaccurate, was made to secure an equal distribution of weight. This practice, however, has long passed by and few truss bridges are now built without the use of bolsters in which the spans can rock on pin bearings. This overcomes one of the difficulties, but not all. It is a great improvement on the older practice. Expansion rollers, however, are generally so small that friction is unnecessarily great and they are often so placed that they soon become filled with dirt, while the repugnance to the use of cast iron has led many designers to avoid it in a place where it is the most suitable possible material. Many bridges are now built in which the weight is transferred to the masonry through a thin plate of wrought iron or steel with guide flanges at the sides made of angle iron between which are a nest of rollers, which are completely shut in by the guides on the bearing surfaces above and below. The thin wall plates are easily deformed unless set with unusual care and the dirt which gets in between the rollers very soon prevents all movement. The old-fashioned sliding plates would really be better than rollers of this kind.

The best practice is to place a heavy wall plate casting on the masonry below the superstructure. This distributes the weight over the pier and keeps the wrought iron members above the masonry where they can easily be protected from rust. It is often forgotten that cast iron is practically an indestructible material, while wrought iron and steel are easily destroyed by rust. Twelve years ago I adopted as a bearing plate for roller bearings a composite plate made of a heavy iron plate at the bottom to which were riveted a series of steel rails, the top surfaces being planed smooth after the whole was riveted up. This forms a stiff bearing plate which is not easily deformed under the weight on the rollers. The dust which collects around the rollers naturally drops into the spaces between the rails, and the rollers can be easily kept clean by working a brush with a long handle from the ends. This plate is made of material which can always be had. I have used it invariably for 12 years. The general practice in this country is to use small rollers. In Europe, rollers of larger diameter are preferred, and as a sufficient motion is obtained without using the whole circumference of the roller segmental rollers have come into use, that is, the unused portions of the rollers are cut off and the rollers put closer together.

In the Memphis bridge I found it necessary to use an expansion bearing to roll under a weight of 2,000 tons, probably the largest weight that was ever provided for in this way. I adopted segmental rollers and this bearing rolls on 30 rollers arranged 15 on each side, the rollers being 15 ins. in diameter and spaces 8 ins. between centers. I used rollers of precisely the same dimensions, but only five in a bearing under the 250-ft. double track spans of the Burlington bridge which I was building at the same time.

The use of these segmental rollers led to designing an expansion bearing which could be adapted to all bridges, and I now use this special bearing everywhere. It consists, first, of the cast iron wall plate on which is the usual rail plate; on this are the rollers, which are made 12 ins. in diameter and placed 6 ins. between centers. On the rollers rests a cast steel bearing plate; the improvements in steel manufacture have placed at our disposal what is virtually a new material. The weight of the truss above is transferred to this bearing plate by a rocker plate; this rocker plate is a steel forging with cylindrical surfaces above and below, the two at right angles to each other. On the upper surface rests the top plate which carries the truss. The rocker plate takes the place of the pin in the bolster, but has the advantage of providing for deflection or irregularity of bearings in both directions instead of in one. The combination provides: first, the stiff support of the rail plate; second, a joint which will work perfectly even if set on a surface which is badly out of level.

There are two features of the present practice of bridge designing on which more weight is laid than seems to me consistent with the best practice; in fact, the practice of to-day in these respects seems to me to bear somewhat the same relation to the best practice of the future, that the free-moving joints and avoidance of stiff connections of 20 years ago did to the best practice of to-day; theoretically they are right, practically they are not important.

The first of these is the use of a single-web system instead of a double-web system; there is no question that in a bridge with a single-web system the danger of the actual strains differing from the calculated strains is reduced to a minimum, and this is the reason why it is now preferred; it is the best practice for structures of moderate dimensions; on the other hand, in large structures, the single system compels the use of members of such sizes that the connection details are often clumsy and unsatisfactory; while the opportunity of using members of one web system to stiffen the members of the other is lost; the slight possible irregularities of strain eliminate another source from which greater irregularities are liable to arise.

Another feature of the present practice is the use of curved or broken chords. This has been adopted for reasons of economy and it undoubtedly saves material. With this form of design the single system becomes practically necessary or the web strains may become indeterminate at the points where the lines of the chord change. The reduction of weight is obtained by throwing into the chords a portion of the shearing strain which is ordinarily carried by the web, the chords become of nearly the same uniform size throughout, and consequently there is less waste of material in them. The web is very much lightened and the reversal of web strains from a moving load, instead of being confined to a few panels in the center, may be extended through nearly the whole span; this necessarily leads to greater distortion under the passage of a load than with straight chords, as every member is liable to be strained nearly to its maximum by the passage of a single load. Furthermore, it becomes necessary to use adjustable counters throughout, as. if the counter strains are resisted by stiffening the tension members, the economy is lost.

The cantilever system of construction has been rather a favorite thing of late years. Many people believe it to be something new, but it is one of the oldest forms of bridge construction. The cantilever has one great advantage over the ordinary truss bridge. It can be erected without falsework, this being an advantage which it shares with the suspension bridge. Cantilever construction has also the advantage over the suspension bridge, in that it is a rigid structure, this being an advantage which it shares with the beam truss. Except in those cases where falsework can not well be used the cantilever is not as good as the ordinary truss. The rigidity of all metallic structures is an elastic rigidity. Though a rigid structure its deflections are much greater than those of a beam truss of equal span. Though the weight of a span of cantilever construction may be lighter than that of a beam truss of equal length the additional material required in anchorages and members beyond the limits of the span makes up for any such saving in weight. A cantilever structure is necessarily more complicated than a beam truss and involves features which may cause lost motion and vibrations. Cantilever construction has one advantage; it is possible to transfer the weight of the superstructure exactly to the center of the pier instead of placing it near the edge of the pier, as must be done with separate spans.

By using cantilever construction the 450-ft. suspended span which forms the central portion of the channel span of the Memphis bridge was raised during the high water season of the winter of 1891 to 1892 without falsework. It could have been raised on falsework, but it could not have been raised until the fall of 1892, and this delay would practically have made nearly a year's difference in the earning capacity of the bridge. In other words, the tool would not have been ready to do its work at the time it was needed.

XYLOLITH, OR WOOD STONE.

Xylolith, or woodstone, says the "Bautechniker," is a material invented in 1883, but only lately introduced to the trade by Otto Serrig & Co., of Pottschappel, near Dresden. It is made of magnesia cement, or calcined magnesite, mixed with sawdust and saturated with a solution of chloride of calcium. This pasty mass is spread out into sheets and submitted to a pressure of about 1,000 lbs. to the sq. in., and then simply dried in the air. The specific gravity of this substance is 1.553, and the fractured surface shows a uniform close grain of a yellow color. It has a tensional resistance when dry of 100 lbs. per sq. in., and when wet about 66 lbs. When immersed in water for 12 hours it takes up 2.1% of its weight, and 3.8% when immersed 216 hours.

When treated for several days with hydrochloric acid it loses 2.3% in weight and shows no loss of weight under boiling in water, brine, soda-lye and solution of sulphates of iron, of copper and of ammonium, alternating the boiling with sudden cooling. Exposure to superheated steam, in a Papin digestor, produced no visible effect. In hardness the material stands between feldspar and quartz, and as a non-conductor of heat it ranks between asbestos and cork.

It stands fire well, and at a red heat it is rendered brittle and crumbles at the edges, but retains its general form and cohesion. This xylolith is supplied in sheets from ¼ in. to 1½ ins. thick, and up to one meter square. It is extensively used in Germany for floors in railway stations, hospitals, etc., and for decks of vessels. It can be sawed, bored and shaped with ordinary woodworking tools. Putty in the joints and a good coat of paint make it entirely waterproof. It is sold in Germany for flooring at about 7 cts. per sq. ft., and the cost of laying adds about 4 cts. more. A former article on this material was given in our issue of July 28, 1892.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago.—Existing Roads.

BALTIMORE & OHIO.—The extension of the Cleveland, Wooster & Muskingum Valley R. R. from Wooster to Millersburg, O., is being graded by a force of about 300 men and 100 teams.

BAY OF QUINTE RY. & NAV. CO.—A force of about 30 teams and 40 men is at work on the extension from Harrowsmith to Sydenham, Ont., 4½ miles, and about three miles of the grading have been completed. The road will be completed about Oct. 1. Ch. Engr., M. J. Butler, Deseronto, Ont.

CINCINNATI, HAMILTON & DAYTON.—Rumors are in circulation that this company thinks favorably of building a branch from Jamestown to Springfield, O., 18 miles. The Board of Trade of Springfield is stated to have taken the matter up and will try to secure the construction of the line.

CONCORD & MONTREAL.—There is talk of extending the Jefferson-Berlin Falls branch from Berlin Falls, N. H., up the Androscoggin River, about 20 miles, to open up timber lands.

PITTSBURG & LAKE ERIE.—It is stated that surveys are being made for an extension of the Pittsburg, McKeesport & Youghiogheny Valley R. R. south through Connellsville and Uniontown, Pa., to the upper West Virginia coalfields.

PONTIAC & PACIFIC JUNCTION.—Work has been commenced on the extension from Fort Coulonge, P. Q., to Pembroke, Ont., 85 miles. The route is through a comparatively level country, and with the exception of the construction of several bridges, will not be expensive. One of the bridges will be over the Ottawa River and of considerable size.

PORTLAND & RUMFORD FALLS.—About one-half of the grading has been completed on the line from Mechanic Falls to the Maine Central R. R., and 400 men are now at work on the line. It is expected to begin the tracklaying in August. Ch. Engr., Frederic Danforth, Mechanic Falls, Me.

SARANAC & LAKE PLACID.—This railway, from Saranac Lake to Lake Placid, N. Y., 10 miles, has been completed and opened for traffic. Maximum curve 12° and maximum grade 82 ft. per mile. Contractors, Brady Bros., Bayonne, N. J.

TOBIQUE VALLEY.—This Nova Scotia road has been completed and opened for traffic from Perth Center, N. S., to Plaster Rock, 28 miles. Four miles of the track have been laid this year. Construction was first begun in 1891 and 14 miles of track laid that year. Ten miles more of the road were completed in 1892 and the remainder as stated above. Lawlor, Connor & Co., St. John, N. B., were the contractors for the last section of 14 miles. The road will become a part of the Canadian Pacific Ry. system.

TOLEDO & OHIO CENTRAL.—About 10 miles of track have been laid on the line from Columbus to

ELEMENTS OF WEATHER IN THE UNITED STATES OF MOST INTEREST TO ENGINEERS FOR THE MONTH OF JUNE, 1893.

[Furnished to Engineering News by the Department of Agriculture.]

	Stations.	Temperature. (Deg. Fahr.)				Wind. Velocity in miles per hour.		Wind. Direction at time of max. velocity.	Precipitation—rain and melted snow—inches.		
		Average	Max.	Min.	Range.	Average	Max.		Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities.	Northfield, Vt.	65.0	89	43	46	7.3	33	N	2.07	0.67	10
	Portland, Me.	60.5	88	46	42	7.2	22	SW	3.62	1.71	10
	New York, N. Y.	69.4	96	53	43	8.7	40	SW	2.56	1.03	8
	Pittsburg, Pa.	71.8	91	52	39	6.4	24	SE	2.87	1.08	10
	Chicago, Ill.	67.8	85	48	37	14.5	50	NE	3.59	1.46	9
	Omaha, Neb.	73.1	90	53	37	7.4	30	S	7.11	3.55	8
	St. Paul, Minn.	71.4	91	47	44	7.7	34	SE	[illegible]	0.81	6
	Duluth, Minn.	60.4	92	42	50	5.7	24	W	1.59	0.91	9
	Bismarck, N. Dak.	66.2	93	42	51	9.8	48	NW	4.33	1.27	9
	Average	67.3	90.6	47.3	43.2	8.3	33.9		3.30	1.39	8.8
Southern Cities.	Washington, D. C.	72.5	95	54	41	5.3	26	NW	1.81	0.68	11
	Louisville, Ky.	74.6	94	56	38	6.3	32	SW	4.56	1.35	9
	St. Louis, Mo.	75.2	93	58	35	9.1	50	NW	3.49	0.68	13
	Savannah, Ga.	78.6	96	63	33	8.0	36	SE	8.50	2.22	14
	Leavenworth, Kan.	73.2	92	52	40	7.5	45	SW	5.64	1.41	13
	Jacksonville, Fla.	80.0	95	68	27	8.0	44	SW	4.66	1.51	13
	Chattanooga, Tenn.	74.6	91	58	33	4.4	27	W	6.31	[illegible]	12
	New Orleans, La.	80.2	94	69	25	8.4	37	N	5.30	3.02	13
	Memphis, Tenn.	76.8	95	59	36	5.8	31	E	[illegible]	0.80	7
	Palestine, Tex.	78.9	96	60	36	4.1	23	SW	5.35	1.66	9
	Average	76.5	94.1	59.7	34.4	6.7	35.1		4.80	1.64	11.4
Western Cities.	Helena, Mont.	56.8	92	36	56	8.9	45	SW	0.82	0.34	8
	Port Angeles, Wash.	52.5	71	40	31	6.5	24	W	1.51	0.80	11
	San Francisco, Cal.	56.5	90	47	43	15.3	40	SW	0.03	0.03	1
	Salt Lake City, Utah	67.0	92	42	50	7.2	35	S	[illegible]	0.04	1
	Denver, Colo.	68.6	91	38	53	7.3	45	NW	0.13	0.08	2
	Yuma, Ariz.	87.1	111	57	54	5.9	27	W	T	T	0
	Santa Fé, N. Mex.	68.4	87	44	43	7.7	29	NE	0.02	0.02	1
	Average	65.3	91	43.4	47.6	8.4	35		0.36	0.19	3.4

Ridgeway, O., 52 miles. J. S. Casement & Co., of Painesvile, O., are the contractors. J. C. Williams, Columbus, O., is the engineer in charge of the work.

Projects and Surveys.

CHERRY SPRINGS.—This company has been chartered to build a railway in Potter Co., Pa. Among the incorporators are: M. E. Olmstead, Pres., Harrisburg, Pa.; N. N. Metcalf, Austin, Pa.; A. W. Goodyear, Buffalo, N. Y.

NEW YORK, NEW ENGLAND & NORTHERN.—Incorporated in New York to construct a standard gage steam road about 50 miles in length from a point on the East River, near the mouth of Leggett's Creek, in New York city, north through New York, Westchester and Putnam counties to a point on the line of the New York & New England R. R., near Brewsters, in Putnam County. The capital is $3,000,000, divided into $100 shares. Among the directors are Archibald A. McLeod and Thomas C. Platt.

Southern.—Existing Roads.

GULF & TENNESSEE.—It is stated that the contract for building this railway from Jackson to Middleton, Tenn., about 40 miles, has been let to Garvey Bros., of Memphis, Tenn. Dr. Frederick Howard, Jackson, Tenn., Pres.

KANAWHA & MICHIGAN.—It is expected to have the line now under construction from Malden, W. Va., along the east bank of the Kanawha River, 31 miles, to a connection with the Chesapeake & Ohio R. R., completed by Sept. 1.

Northwest—Existing Roads.

DULUTH & IRON RANGE.—The branch from Biwabik, Minn., to the Franklin mines has been completed and work has been stopped by the company. The branch as built has light grades and curves.

Projects and Surveys.

DANVILLE COAL BELT.—This company has been chartered to build several short lines of railway entirely within the coalfields of Illinois. Among the incorporators are: H. W. Holman, C. S. Jones, W. B. Woodman and others, of Chicago, Ill., where the principal offices will be.

Southwest.—Existing Roads.

GALVESTON & WESTERN.—At a recent meeting of the stockholders the directors were authorized to amend the charter so as to increase the capital stock to $2,000,000 and to extend the road west to the San Antonio River, east to the Sabine River and north to Houston.

Projects and Surveys.

KANSAS, OKLAHOMA CENTRAL & SOUTHERN.—Chartered in Oklahoma to build a line from Stevens, a station in the Cherokee Nation, through Pawnee Indian Reservation, Payne, Logan, Oklahoma and Canadian counties, and the Wichita, Comanche, Arapaho and Kiowa reservations to Vernon, Tex.

SEDALIA, WARSAW & SOUTHERN.—Mr. Dwight Tredway, of St. Louis, Mo., is reported as saying that Mr. Carlos S. Greeley and other St. Louis business men are interested with himself in the Springfield & Sedalia Construction Co., and that it is the intention to build a railroad from Sedalia to Springfield, Mo. They propose to take in the Sedalia, Warsaw & Southern, a narrow gage line of 40 miles, between Sedalia and Warsaw, partly owned by the Missouri Pacific, and to make it standard gage, and to construct a new line from Warsaw to Springfield, making a complete line of 133 miles. Owing to present financial conditions active work will not commence before the fall.

Rocky Mt. and Pacific.—Existing Roads.

MONTEREY & FRESNO.—Gen. Man. H. A. Green, Monterey, Cal., writes us that the contract for building this railway has been let to the California Construction Co., Nucleus Building, San Francisco, Cal. The preliminary survey has been completed and a line 163 miles long secured between Monterey and Fresno, Cal., with grades not exceeding 1½% and curves 10°. The locating surveys are now under way. Starting from Monterey the road will pass through Blanco. Salinas, San Juan and Hallister to Fresno. There will be one large bridge and several short tunnels, but generally the work will not be very difficult. The principal business of the road will be in grain, hay, fruit, wines, cattle, lime, ores, coal, lumber and general merchandise.

NORTHERN PACIFIC.—About 50 men are now at work on the extension of the Seattle, Lake Shore & Eastern R. R. from Sumas, Wash., to Vancouver, B. C., 47 miles, known as the Burrard Inlet & Fraser Valley R. R. The line is through a level country. Nearly all of the right of way has been secured and bonuses of $300,000 and $250,000, respectively, obtained from the cities of Vancouver and New Westminster, B. C. Contracts for the construction of the road will be let about Aug. 15.

Projects and Surveys.

INDEPENDENCE & SALEM.—R. D. Cooper, Independence, Ore., writes us that this railway will be 11 miles long, and that no work will be done until money gets easier.

STREET RAILWAYS.

LIMERICK, ME.—Preliminary surveys have been made for an electric railway from the Portland & Rochester R. R. at Centre Waterboro to this city, a distance of ten miles; estimated cost, $80,000.

HOLBROOK, MASS.—The American R. R. Improvement Co. has been granted a franchise for constructing an electric railway which will form a belt line connecting this place with Randolph and South Braintree, and thence to Quincy and Boston.

MIDDLEBOROUGH, MASS.—An electric railway is projected from this city to New Bedford by way of the lakes; estimated cost, $200,000.

STONEHAM, MASS.—The Mystic Valley St. Ry. Co. has petitioned the selectmen for a franchise for an electric railway from this place to Winchester, and eventually to extend the road to Arlington. All the stock for the proposed railway has been subscribed for, and is held by prominent residents of the three towns through which the road will operate. The following are among the directors: A. L. Wyman, G. E. Smith, H. C. Brooks, John B. Humphrey.

WORCESTER, MASS.—The Worcester Consolidated St. Ry. Co is reported as about to petition for a franchise for important extensions

BRIDGEPORT, CONN.—The Bridgeport Ry. Co., Bridgeport Horse Ry. Co. and the East End Ry. Co. have consolidated under the name of the Bridgeport Traction Co.; capital stock, $2,000,000; Pres., Col. N. H. Heft. The roads are soon to be operated by electricity.

WINDSOR LOCKS, CONN.—Surveys are about to be made for an electric railway between Rainboro, Poquonock and this place.

AMSTERDAM, N. Y.—J. R. Snell, Gen. Man. Amsterdam St. Ry. Co., is reported as stating that the road will be extended to Rockton this fall and that the proposed road to Johnstown and Gloversville will be built within a year. The latter line is estimated to cost about $200,000 and will probably be operated by a separate company.

EASTON, PA.—It is stated that the Easton & South Easton Ry. Co. will construct its proposed road as soon as a franchise is secured.

HOLLIDAYSBURG, PA.—Stock to the amount of $25,000 has been subscribed toward building an electric railway between this place and Duncansville. An application for a charter has been made and preparations are being made to commence work as soon as possible.

FREDERICK, MD.—The contract for the line work of the Frederick & Middletown Valley Electric Ry., about eight miles long, has been awarded to the Hughes & Rigby Engineering Co., Baltimore. There were about 15 bids, ranging, it is reported, from about $85,000 to $115,000. Construction will be commenced at once. The road is estimated to cost $210,000.

LAUREL, MD.—The Mayor has vetoed the ordinance granting a franchise for an electric railway to Baltimore. New propositions are now being considered, including one for a local road.

WASHINGTON, D. C.—Ch. Engr. Schoepf, of the Washington & Baltimore Electric Ry. Co., is reported as stating that the main features of the proposed road have been decided upon and that actual construction will begin about Sept. 1. The line has been surveyed to Hyattsville. The maximum grade will be 5% and 100-lb. T rails will be used upon the entire road.

MEMPHIS, TENN.—The Citizens' St. R. R. Co. is about to make important extensions, according to reports.

NASHVILLE, TEN.—The charter of the McMinnville & Smithville Electric Ry. Co. has been filed with the secretary of state by W. G. Crowley, J. L. Calvert, A. B. Hooper and others. It is proposed to construct an electric railway from the extremity of the Sparta branch of the Nashville, Chattanooga & St. Louis Ry. to Smithville, De Kalb Co., and from there to the Nashville & Knoxville R. R., at a point near Silver Point, Putnam Co., with lateral and extension lines, if necessary, the whole to be less than 100 miles long.

WINCHESTER, TENN.—The work of grading for the electric railway between this city and Decherd will be completed within a few weeks, and it is reported that negotiations are pending for an extension of the road from this city to Lynchburg, in Moore Co., a distance of 20 miles.

CLEVELAND, O.—The Cleveland Electric Ry. Co. has been granted authority to extend its lines in several streets.——It is reported that the Cleveland City Ry. Co. will soon change its Payne Ave. line, 3¼ miles long, from cable to electric power.

DAYTON, O.—The Dayton Traction Co. has been granted a franchise.

PORTSMOUTH, O.—Work on the Portsmouth Electric St. Ry. was commenced July 20. Pres., Geo. Davis.

KILLMASTER, MICH.—The Killmaster R. R. Co. has been incorporated; capital stock, $25,000.

OAKLAND, CAL.—The board of supervisors have granted a franchise to Welles Whitmore and Edwin K. Alsip for an electric railway from the northern boundary of this city to the town of Berkeley.

SAN FRANCISCO, CAL.—A franchise has been granted to the East Oakland Ry. Co.

PORT DALHOUSIE, ONT.—The Port Dalhousie, St. Catharines & Thoeold Electric St. Ry. Co. has been incorporated; capital stock, $100,000.

HIGHWAYS.

NEW YORK.—The Washington Ridge Road Commission, 115 Broadway, New York, will receive bids until Sept. 11 for about 7,077 cu. yds. earth excavation, 8,000 cu. yds. rock excavation, 3,000 cu. yds. embankment and 1,472 cu. yds. dry masonry.——The commissioners for macadamizing the Jamaica town road have voted to advertise for bids for macadamizing Hillside Ave.

NEW JERSEY.—Surveys have been made by Asher Atkinson, Co. Engr., New Brunswick, for a highway between Sayreville and South Amboy, a distance of 5¼ miles.——R. and C. W. Burlew and C. J. Blew are members of a commission appointed by the court of Middlesex Co. to make surveys for a new highway in Madison township.

PENNSYLVANIA.—A. B. Dunning has completed surveys for a boulevard between Scranton and Elmhurst, 7⅛ miles long. Contracts for the construction will soon be awarded, according to reports.

OHIO.—Prof. T. C. Ferguson, Kenton, has completed plans for the Cooney pike; length, 5½ miles; estimated cost, $20,000.

INDIANA.—At an election at Seymour July 22 it was voted to construct four gravel roads to the township line; estimated cost, $40,000.

TEXAS.—The commissioners of Wood county have appropriated $7,500 for a highway 1¼ miles long across the Sabine bottom south of Mineola. for which surveys are being made.

NEW COMPANIES.—Columbia & Ashland Gravel Co., Columbia, Mo.; $9,800; J. H. Parker, S. E. Lenoir, Geo. Bradford.——Rollinsville & Middle Park Wagon & Toll Road Co., Rollinsville, Colo.; $10,000; J. J. A. Rollins, F. T. Gooch, W. L. Roberts.——Cottonwood Creek & Big Lake Wagon Road Co., Annabella, Utah; $700; Pres., R. H. Barney; Secy., W. L. Parks.

BRIDGES.

CHESTER, PA.—Bids will soon be asked for building a viaduct 433 ft. long to connect this city with Shoemakerville.

ELKTON, MD.—The commissioners of Cecil Co., Md., will receive separate bids for the ironwork and masonry for two bridges until July 26. Bids will also be received until Aug. 3 for the masonry and ironwork of a third bridge. C. H. Smith, Clk. Co. Comrs

MILFORD, O.—A bridge is to be built over the Miami River. It will be 280 ft. long and cost $50,000.

INDIANAPOLIS, IND.—Bids will be received until Aug. 28 for building a bridge, both substructure and superstructure, over the White River, at Kentucky Ave. Address the county commissioners.

WATER-WORKS.

MANCHESTER, N. H.—Bonds for $100,000 for the new high-pressure service have been sold.

BRANDON, VT.—Surveys have been made by A. R. Dow, Burlington, for a supply from Fern Lake. An election was called for July 26 to vote on the question.

NEWPORT, VT.—It is reported that Joel Foster, Montpelier, is making surveys for a new supply.

BOSTON, MASS.—The lowest bid for building dam No. 5 at Southboro was that of Jones & Meehan, Boston, $420,784 for paved slopes, or $427,924 for riprapped aslopes. Bids are asked until Aug. 9 for a distribution system at Fort Warren from a 4-in. pipe already laid. Lieut. L. S. Lyon, A. A. Q. M.

NEWBURYPORT, MASS.—The Newburyport Water Co. has begun work on a system of filtration of Merrimac River water for supplying its customers with the quantity daily demanded and which the present plant proves inadequate to do.

NORTH ATTLEBORO, MASS.—It is reported that the commissioners have asked for bids for the pump recently authorized.

WEBSTER, MASS.—The contract for pipe has been awarded to the Jackson & Woodin Mfg. Co., as stated in another column. The supply will be pumped from a well 25 ft. in diameter into a stand-pipe 30 × 100 ft. The contract for laying the pipe will soon be awarded.

WORCESTER, MASS.—Orders have been adopted by the council for laying 8 and 12-in. pipe, at a cost of about $10,000.

NEW BRITAIN, CONN.—The council has instructed the mayor to issue water bonds for $200,000, also to borrow $8,000 to complete the work at Shuttle Meadow.

COHOCTON, N. Y.—Jas. E. Larrowe is making surveys for works.

CORTLAND, N. Y.—The Cortland Water-Works Co. has purchased land to increase the capacity of its reservoir.

FAIRPORT, N. Y.—The contract for a 6-in. test well has been awarded to Burton & Crane, Honeoye Falls. Bids for material and construction of works will be opened Aug. 7; estimated cost, $40,000; C. L. Peacock, Chn. Bd.

FRANKFORT, N. Y.—The election July 18 resulted in favor of the proposed works, by a vote of 162 to 55.

JAMESTOWN, N. Y.—An election will be held Aug. 3 to vote on the issue of bonds for $250,000 for the purpose of building a municipal plant.

LOWVILLE, N. Y.—The citizens have voted to issue bonds for $65,000 for works. A 6,500,000-gallon reservoir will be constructed, and it is hoped to have the works completed by Jan. 1, 1894.

MONTGOMERY, N. Y.—Plans for works have been completed and are now open for inspection; estimated cost, $16,000 to $25,000.

MOUNT KISCO, N. Y.—It is reported that an election will be held next month to vote on the question of works.

NEW YORK, N. Y.—The department of public works will receive bids until Aug. 7 for mains in about 25 streets.

PENN YAN, N. Y.—The necessity of works is being urged, as a result of a recent fire.

ROCHESTER, N. Y.—Contracts for 60-in. pipe and joints have been awarded to the lowest bidders at prices published last week.——The proposed dam in the Genesee River is for water storage for canal and power purposes, according to reports.

ALTOONA, PA.—The council has directed that new bids be asked for building an impounding reservoir, the contract for which was recently awarded.

BELLWOOD, PA.—The citizens have voted to issue bonds for works; estimated cost, $15,000 exclusive of dam or reservoir.

MAHANOY CITY, PA.—Bonds for $100,000 are to be issued. W. P. Quinn & Co., Pottsville, have been awarded a contract, at $84,156.

McKEESPORT, PA.—Only one bid was received for a pumping station and the clerk has been directed to re-advertise the work; also to advertise for pipe for a main in Evans Ave.

NEWPORT, PA.—It is reported that the contract for works has been awarded to Howard Ahrens, Reading.

PITTSBURG, PA.—E. M. Bigelow, Ch. Dept. Pub. Wks., has ordered the immediate purchase of a number of meters, and, according to reports, will recommend the adoption of the meter system. The contract for two high-duty, 10,000,000-gallon pumps has been awarded to the Holly Mfg. Co., Lockport, N. Y., at $147,820.

WILKINSBURGH, PA.—The Suburban Water Co. of Allegheny County will receive bids until Aug. 5 for works, as stated in our advertising columns. Jas. H. Harlow & Co., Engrs.

WASHINGTON, D. C.—Land at Fort Reno has been purchased for a 2,000,000-gallon reservoir for the residents of Tennallytown. Bids will soon be asked for constructing a 12-in main to this place. Plans have been prepared for a 24-in. main to connect the reservoir with the new pump house proposed by Capt. Lusk, which is to adjoin the Georgetown distributing reservoir.

MOUNDSVILLE, W. VA.—The proposal to construct works is reported as being generally approved.

QUINCY, FLA.—H. J. Davis writes us that there is a prospect of an artesian supply being secured; population, 600; A. L. Wilson, Chn. Bd.

DAYTON, O.—Bids are asked until Aug. 15 for a steel reservoir tank, 16 × 60 ft., with masonry foundation, for the Dayton Asylum for the Insane. Oscar

Sheppard, Pres. Bd. of Trustees. John W. Hill, Consult. Engr., Cincinnati.——The city comptroller will receive bids until July 31 for service pipes in two streets.

NORWOOD, O.—Contracts have been awarded as follows: Stacy Mfg. Co., reservoir, $19,460; Wm. Stewart & Sons, pump house, $5,945; Laidlaw & Dunn Co., pumps, $7,000.

ORRVILLE, O.—Bids for works will be received until Aug. 22, as stated in our advertising columns. H. S. Wertz, Vil. Clk. Alexander Potter, Consult. Engr., New York.——The council has authorized the sale of $25,000 of 6% bonds.

PLAIN CITY, O.—A water-works and electric light plant will be constructed at a cost of $33,000, according to reports.

AURORA, IND.—It is reported that a well will be sunk as an experiment and if a desirable supply is secured works will be constructed.

BRAZIL, IND.—The council has directed that the works be sold to the highest bidder. They were built in 1875 by the town and cost $50,000.

EVANSVILLE, IND.—The council has adopted the recommendations of the water-works trustees that premiums of $1,000, $500 and $250 be awarded for competitive plans for works. The plans must provide for a 20,000,000-gallon plant, and be submitted by Sept. 18.

ALBION, MICH.—The city has voted to issue bonds for extensions.

ANN ARBOR, MICH.—A committee has been appointed to consider an additional supply.

CARSONVILLE, MICH.—An election was held July 24 to vote on the issue of bonds for $15,000 for works.

MANTON, MICH.—The citizens have voted in favor of works.

AUSTIN, ILL.—We are informed by Ed. S. Austin, Clk. town of Cicero, that the contract for pipe, valves, etc., according to advertisement, was awarded to Geo. C. Morgan, at $85,202, and the contract for pumping station, exclusive of stand-pipe, to H. A. Lovell, at $8,750.

CHICAGO, ILL.—The city engineer has reported that it will cost $1,200,000 and take three years to extend the two-mile tunnels three miles further into the lake.

FARMER CITY, ILL.—Bids are asked until Aug. 7 for works, including steel stand-pipe, 65 tons pipe, pump, etc. J. F. Holt, Cy. Clk.

GARDNER, ILL.—Works will soon be constructed, according to reports.

ASHLAND, WIS.—A new company is being organized by Dr. Rinehart and others to pipe spring water from Prentise Park.——The Ashland Water Co. is talking of putting in larger pumps.

LA CROSSE, WIS.—The board of public works will receive bids until July 31 for 6-in. mains in three streets.

REEDSBURG, WIS.—A special election has been called to vote on the question of works; estimated cost, $30,000 to $40,000.

SCHALLER, IA.—The proposition to issue bonds for works was lost by five votes, according to reports.

DULUTH, MINN.—A. E. Cooper, Cy. Engr., West Duluth, has recommended that this city, West Duluth, Superior, Lakeside, and later on Ironton and New Duluth unite in securing a better supply.

ST. PAUL, MINN.—The commissioners will receive bids until Aug. 3 for 20 tons of ⅝-in. extra strong lead pipe.

CEDAR RAPIDS, NEB.—E. L. Sargent informs us that a supply is proposed from wells, and that an engineer is wanted to prepare plans; estimated cost of works, $8,000 to $9,000; population, 800. It is hoped to award contracts for the construction next month. L. D. Groom, Chn. Com.

DILLON, MONT.—The contract for works has been awarded to the San Francisco Bridge Co., at $46,500. N. C. Ray, Butte, has been engaged to superintend the construction.

KIRKWOOD, MO.—It is reported that a company is negotiating with the town board for a franchise.

ST. LOUIS, MO.—Extensions have been ordered estimated to cost about $50,000.

HILLSBORO, TEX.—The Hillsboro Water, Light & Power Co. will receive bids until Aug. 10 for works. D M. Crosthwait, Pres., Kyle.

KAUFMAN, TEX.—We are informed by J. S. Terry, Cy. Clk., that the J. O. H. Bennett Water Supply Co. has made a proposition to furnish the city with an artesian supply; estimated cost of works, $25,000.

PARIS, TEX.—J. M. Gose is chairman of a committee that is investigating the question of an additional supply.

STEPHENVILLE, TEX.—The council has decided to put in works, and has appointed a committee to take the necessary steps.

DENVER, COLO.—The property of the Denver City Water Co. has been ordered sold to satisfy a mortgage of $2,500,000.

SUMNER, WASH.—The citizens have voted in favor of works. It is hoped to commence the construction next month.

WENATCHEE, WASH.—An election will soon be held to vote on the issue of bonds for works.

PORTLAND, ORE.—Bids will be received until Aug. 15 for submerged pipes, as stated in our advertising columns. Isaac W. Smith, Ch. Engr.

ALAMEDA, CAL.—W. B. Farwell, Pres. Alvarado Artesian Water-Works Co., noted July 13 as incorporated, has made the city a proposition for a supply.

SAN BERNARDINO, CAL.—The Mount Vernon Water & Power Co. has been incorporated by John L. Campbell, H. B. Mascott, C. W. Allen and others; capital stock, $52,500.

SALT LAKE CITY, UTAH.—The Forest Dale Water Co. has been incorporated: capital stock, $50,000; Pres., Geo. M. Cannon; Tres., M. C. Morris. The mains are being laid under the direction of F. M. Lyman, Engr.

COEUR D'ALENE, IDAHO.—We are informed that the Coeur d'Alene Water-Works Co. will construct a 500,000-gallon reservoir. C. A. De Saussure, Supt.

IDAHO FALLS, IDAHO.—Jno. M. Taylor, Engr., informs us that an election will be held Aug. 21 to vote on the issue of bonds for $20,000 for works and other improvements.

COWANSVILLE, QUE.—Surveys have been made for works, the supply to be taken from a lake about three miles distant.

WINDSOR MILLS, QUE.—Arrangements have been completed for a gravity supply for fire and domestic purposes. The construction will be under the direction of L. Achille Dufresne, Engr.

ARTESIAN WELLS.

BETHLEHEM, PA.—The town council has voted to sink an artesian well.

GRAND JUNCTION, COLO.—The Western Colorado Investment Co. will sink several artesian wells near this place.

IRRIGATION.

EL PASO, TEX.—B. W. Grover, Man. Rio Grande Irrigation Canal Co., has been instructed to visit the Mimbres River, in New Mexico, and inspect the bedrock dam there, with a view to constructing a similar dam near this city, as stated last week. It is stated that the dam alone is estimated to cost about $2,000,000.

SHERIDAN, WYO.—Water Commissioner Dow and others are reported as in the mountains selecting sites for water storage reservoirs to be used in conjunction with the Peralto ditch, a large irrigation project.

COLTON, CAL.—The Olive Irrigation District will receive bids until Aug. 8 for $60,000 of bonds. Geo. E. Burrall, Secy.

ESCONDIDO, CAL.—Bids are asked until Sept. 5 for the construction of the Escondido irrigation system, as stated in our advertising columns. A. J. Werden, Secy.

NEW COMPANIES.—Payette & Weiser Ditch Co., Weiser, Idaho; $100,000; E. M. Barton, L. E. Young, D. M. Baker.——Big Timber Ditch Co., Big Timber, Mont.; $75,000; J. A. Hill, Geo. M. Hatch, T. K. Lee.—Pacific Irrigation & Land Co., Tacoma, Wash.; $100,000; C D. V. Utter, L. D. Hill, S. D McDonald

SEWERS.

EVERETT, MASS.—The city engineer will receive bids until July 31 for about 1,000 lin. ft. 12 to 8-in. pipe sewers.

PITTSFIELD, MASS.—The commissioners will receive bids until Aug. 5 for constructing sewers; pipe, etc., to be furnished by the city. Ernest W. Bowditch, Engr.

NEW BRITAIN, CONN.—The commissioners have estimated the cost of extending the Hartford Ave. sewer 300 ft. to be $14,440.——The council has appropriated $25,000 for sewers.

SOUTH NORWALK, CONN.—Plans have been prepared for 1,200 ft. of brick sewer, estimated to cost $10,000. F. S. Morehouse, Cy. Engr.

BUFFALO, N. Y.—The department of public works will receive bids until Aug. for about 4,000 lin. ft. of 10 to 15-in. tile sewers.

CASTILE, N. Y.—It is reported that a sewer will be constructed.

CLINTON, N. Y.—The notice of sewer letting has been withdrawn, owing to difficulty in securing the necessary right of way and the stringency of the money market. Edward B. Stanley, Clk. Bd.

CORTLAND, N. Y.—Fred. Hatch, Cy. Clk., informs us that sewers have been voted for, but that no work is likely to be done this year.

NEWBURG, N. Y.—Bids will be received until Aug. 1 for a sewer in Montgomery St. D. J. Coutant, Cy. Clk.

SCHENECTADY, N. Y.—Bids are asked until July 29 for 207 lin. ft. 5 × 4½-ft. brick sewer and 6,000 lin. ft. 18 and 20-in. pipe sewer, average cut 7 and 8 ft., respectively. De Witt C. Smith, Cy. Engr.

SIDNEY, N. Y.—The commissioners will receive bids until July 31 for sewers in three streets. C. H. Seeley, Clk.

TROY, N. Y.—The council has voted to construct 12 and 15-in. pipe sewers.

YONKERS, N. Y.—The contract for a sewer in South Broadway has been awarded to A. Murphy, at $23,500.——Bids will be received until Aug. 14 for two sewers. John Pagan, Jr., Cy. Clk.

BRADFORD, PA.—Bids will be received until Aug. 7 for 1,450 ft. 15-in., 1,876 ft. 12-in., 2,410 ft. 10-in. and 7,000 ft. 8-in. pipe sewers. J. A. Lindsey, Cy. Clk.

PITTSBURG, PA.—The board of public works will receive bids for 17 lateral and four main sewers.

SMYRNA, DEL.—An election was held July 25 to vote on the issue of bonds for a system.

BALTIMORE, MD.—Mendes Cohen has been elected president of the sewerage commission, recently noted as appointed to investigate the question of a general system.

WASHINGTON, D. C.—The district commissioners will receive bids until Aug. 5 for constructing sewers.

NORFOLK, VA.—A petition has been presented for increased pumping facilities.

ASHLAND, KY.—Bids will be received until July 31 for a 25-in. pipe sewer in 17th St., about 3,200 lin. ft. Thos. Boggess, Jr., Cy. Engr.

CINCINNATI, O.—The board of administration will receive bids until Aug. 16 and 17 for sewers.

CLEVELAND, O.—The board of control will receive bids until Aug. 2 for four sewers.——The council has voted to issue $29,000 of bonds for sewers in two streets.

DAYTON, O.—Bids will be received until July 31 for house sewer connections in two streets. C. A. Herbig, Cy. Compt.—The council has voted to construct five sewers.—Two contracts have been awarded to A. B. Bartow, at $210,000

HAMILTON, O.—A resolution has been introduced into the council instructing the city engineer to ascertain the cost of plans for a system.

FORT WAYNE, IND.—The sewer committee will recommend to the council that a 10-ft. sewer, about a mile in length, be constructed, at an estimated cost of $100,000.

ANN ARBOR, MICH.—Bids are asked until Aug. 9 for 6,550 ft. 24-in., 2,600 ft. 20-in., 3,500 ft. 15-in. and 2,100 ft. 10-in. pipe sewers; average cut, 10 ft.; estimated cost, $30,000. Geo. F. Key, Cy. Engr.

ST. JOSEPH, MICH.—The contract for a system has been awarded to Denler & Scott, Port Huron, at $16,478.

CARTHAGE, ILL.—C. A. Gilchrist, Chicago, has prepared plans for 5,000 lin. ft. of 18 and 12-in. pipe sewers; estimated cost, $1 and 75 cts. per lin. ft., respectively, for 18 and 12-in. sewers. A. N. Chenill, Chn. Com.

GREEN BAY, WIS.—Bids will be received until Aug. 4 for 12 to 8-in. pipe sewers in three streets. X. Parmentier, Cy. Clk.

DULUTH, MINN.—Important extensions are proposed. D. A. Reed, Cy. Engr.

WEST DULUTH, MINN.—A. S. Cooper, Cy. Engr., informs us that about $60,000 worth of sewer work will probably be ordered

FREMONT, NEB.—The contract for 73,663 lin. ft. of pipe sewers, 80 manholes, etc., has been awarded to McDonald, Penfield & Co., at $35,126.

GALVESTON, TEX.—The Galveston Sewer Co. has increased its capital stock to $80,000.

SEATTLE, WASH.—The council has directed that bids be asked for $95,000 of sewer tunnel bonds.

PORTLAND, ORE.—The council has voted to construct a 24 to 12-in. pipe sewer on East 12th St. Plans have been prepared for seven sewers, for which bids will soon be asked.

STREETS.

NEWTON, MASS.—The council has appropriated $6,000 for constructing the roadway of a new boulevard.

BROOKLYN, N. Y.—The town board of New Utrecht has voted to open and grade 66th St., from Fort Hamilton Ave. to the bay.

BUFFALO, N. Y.—The department of public works will receive bids until Aug. 3 for repaving Scott St. with asphalt, Medina sandstone or brick. The council has voted to pave five streets with asphalt and one with brick. The contract for paving one street with Trinidad asphalt has been let to the Barber Asphalt Paving Co., at $44,417.

DUNKIRK, N. Y.—The council has declared its intention to pave Buffalo St., a distance of 1¼ miles.

NEW YORK, N. Y.—Bids will be received until Aug. 4 for grading, curbing, flagging and paving with granite blocks; two contracts. Louis F. Haffen, 2622 Third Ave.

SCHENECTADY, N. Y.—Bids will be received by the council until Aug. 8 for grading one street.—The council has voted to grade, curb and flag two streets, and pave one with asphalt.

TROY, N. Y.—The council has voted to pave one street each with asphalt and granite blocks and two with brick.

UTICA, N. Y.—The Utica Paving Co. has been incorporated by Chas. I. Williams, W. P. Fish, H. W. Millar and others; capital stock, $25,000.

YONKERS, N. Y.—The council has voted to issue $50,000 of street improvement bonds. Bids will be received until Aug. 14 for macadamizing two streets. John Pagan, Jr., Cy. Clk.

ANNAPOLIS, MD.—It is proposed to issue bonds for paving.

ANNISTON, ALA.—The council has voted to grade and macadamize three streets.

NEW ORLEANS, LA.—The council has been petitioned to pave five streets with concrete gravel.

DANVILLE, KY.—A new street, 50 ft. wide, is to be opened.

CINCINNATI, O.—The board of administration will receive bids until Aug. 3, 11 and 18 for grading and paving with brick and macadam, five streets.

COLUMBUS, O.—The city engineer has been directed to prepare plans for improving five streets.

DAYTON, O.—The council has voted to improve twelve streets.

HAMILTON, O.—Bids will be received until Aug. 1 for grading, curbing and paving nine streets with brick and cement. J. J. McMaken, Cy. Clk.—The city engineer is preparing plans for 2,803 lin. ft. of asphalt paving.

MANSFIELD, O.—Bids will be received until Aug. 19 for street improvements. F. M. Remy, Cy. Clk.

MARIETTA, O.—Bids will be received until Aug. 12 for 27,311 sq. yds. brick paving and 18,829 lin. ft. sandstone curbing. L. Mueller, Cy. Clk.

TOLEDO, O.—Bids are asked until Aug. 7 for grading and paving. Sylvester Lamb, Cy. Clk.

RICHMOND, IND.—The board of public improvements will receive bids until Aug. 18 for grading, graveling and paving with brick; five contracts.

SOUTH BEND, IND.—Bids will be received until Aug. 14 for cement sidewalks in five streets. L. A. Hull, Cy. Clk.

WASHINGTON, IND.—It is reported that five miles of paving will be constructed this fall.

AURORA, ILL.—Bids are asked until Aug. 5 for 13,000 sq. yds. cedar block paving, 2,960 sq. yds. brick paving and 6,296 lin. ft. stone curbing. N. Cass, Chn. Com.

VENICE, ILL.—E. E. Rutledge informs us that he is constructing a vitrified brick street; estimated cost, $32,000.

KEOKUK, IA.—Bids are asked until Aug. 7 for paving with macadam, three contracts. W. H. Jones, Cy. Engr.

MARSHALLTOWN, IA.—Wm. Bremner, Cy. Engr., informs us that the city contemplates advertising for about ½ mile of additional brick paving. A contract was awarded some time ago for paving about 20,000 sq. yds. with brick.

ST CHARLES, MO.—The council has voted to improve Pike St., from Main to Sixth Sts.

PASADENA, CAL.—The contract for paving two streets with asphalt has been awarded to the Perrine Contracting & Paving Co., San Francisco, at about $30,000.

OREGON CITY, ORE.—The following bids have been received for paving Main St. with vitrified brick: Pacific Bridge Co., $42,153; Portland Pressed Brick Co. $38,345; American Bridge Co., $37,758.

ELECTRIC LIGHT AND POWER.

WESTFIELD, MASS.—J. J. Kirkpatrick, Holyoke, is preparing surveys for the proposed dam at Chester for an electric plant to be erected by residents of this city.

FLATBUSH, N. Y.—A franchise has been granted to the Knickerbocker Electric Light & Power Co. The wires will be extended throughout Parkville, Windsor Terrace and eKnsington as well as through the town proper. Pres., Richard Ficken.

MIDDLETOWN, N. Y.—W. D. Stratton, H. W. Corey, E. A. Brown and others have organized the Middletown Pipe Line & Power Co. to develop the water power of the Neversink River. The plans include a dam 25 or 30 ft. high at Eden Falls, in the town of Forestburgh, with power-house, etc., expected to develop 5,000 to 8,000 E. HP.; capital stock, $50,000.

SMYRNA, DEL.—An election was held July 24 to vote on the issue of bonds for electric lights; carried.

ELLICOTT CITY, MD.—The Ellicott City Electric Light Co. is reported as about to double the capacity of its plant.

DANVILLE, KY.—According to press reports the water power at the Falls of Cumberland, Whitley Co., has been purchased by a syndicate which will establish an electric plant there. The plans include the furnishing of electric light and power and the building of an electric railway from Jellico, Tenn., to the Cincinnati Southern R. R. by way of Williamsburg.

FINDLAY, O.—Contracts for electric lights for five years have been awarded to the Hancock Light & Power Co., at $69.50 per light per year for 135 arc lights, and to the Findlay Electric Light & Power Co. at $10 per year for each incandescent light.

MADISONVILLE, O.—A special election will be held Aug. 26 to vote on the issue of bonds for an electric light plant.

DETROIT, MICH.—A site has been decided upon for a municipal electric light plant and the commissioners are reported as selecting the necessary equipments.

JOLIET, ILL.—The following bids were received for an electric light plant at the penitentiary, the address being Chicago unless otherwise stated: Complete plant: Westinghouse Mfg. Co., $56,300; Waddell-Entz Co., $56,552; General Electric Co., $58,458. Four boilers: Heine Safety Boiler Co., No. 1, $19,950; No. 2, $20,350; Babcock & Wilcox, No. 1, $14,978; No. 2, $19,059; Campbell & Zell, Boiler Co., No. 1, $21,435; No. 2, $22,535; Sterling Boiler Co., $20,400; National Watertube Boiler Co., $14,600. Electrical apparatus: Fort Wayne Electric Co., $15,060; Western Electric Co., $18,960; Waddell-Entz Co., $19,725; Westinghouse Electric Mfg. Co., $13,926; General Electric Co., $13,698. Corliss engine: E. P. Allis & Co., Milwaukee, $10,200; Lake Erie Engineering Co., Buffalo, $9,250; Hoven, Owen & Pentschler, $8,725; C. J. Cooper & Co., Mount Vernon, O., $9,550; Bates Machine Co., Joliet, including bolting, etc., $14,827.

MAYVILLE, WIS.—It is reported that the council is negotiating for an electric light plant.

HILLSBORO, TEX.—The Hillsboro Water, Light & Power Co. will receive bids until Aug. 10 for an electric light plant. D. M. Crosthwait, Pres., Kyle.

NEW COMPANIES.—Centralia Light & Power Co., Salem, Ill.; $31,000; E. S. Condit, Jacob Kohl, G. L. Pittinger.——Dubuque Light & Traction Co., Dubuque, Ia.; $600,000; operating electric light and street railway plants.——Enosburgh Electric Light & Power Co., Enosburgh Falls, Vt.; $10,000.—Santa Monica Electric & Power Co., Santa Monica, Cal.; $40,000.

CONTRACT PRICES.

PIPE.—Webster, Mass.—The contract for about 700 tons of cast iron pipe has been awarded by the water commissioners to the Jackson & Woodin Mfg. Co., Berwick, Pa., at $26.75 per gross ton for 6 to 12-in. pipe, and $27.75 for 16-in. pipe.

Springfield, O.—A contract for about 127 tons of pipe has been awarded by the water-works committee to the Ohio Pipe Co., Columbus, at $20.50 per ton.

Chicago, Ill.—Bids were opened July 20 for about $300,000 worth of pipe for extensions of the water system to the districts about Roseland and Humboldt Park. The only bid received for the whole amount was a joint one submitted by Dennis Long & Co., Louisville, Ky., the Addyston Pipe & Steel Co., Cincinnati, and the Howard-Harrison Iron Co., St. Louis. at $25.90 per ton for pipe delivered on the ground where needed. The Buffalo Cast Iron Pipe Co. bid $26.40 for a part of the pipe, and the Lake Shore Foundry $26.50.

ASPHALT PAVING.—Pasadena, Cal.—The contracts for paving two streets with asphalt has been awarded to the Perrine Contracting & Paving Co., San Francisco, at 31 cts. per sq. ft.; total amount, about $30,000.

BRICK PAVING.—Lockport, N. Y.—The contract for paving Mulberry St. has been awarded to Chas. Whitmore & Co., at $2.12 per sq. yd., John Porter Co.'s fireclay brick to be used.

Lyons, Ia.—The following bids were received for paving Sixth and Seventh Sts: Lyons Const. Co., excavating and grading, 24 cts. per cu. yd.; curbing with stone, 5 × 20 ins., at 57 cts., and with brick at 14 cts. per lin. ft.; one course paving at $1.38½ per sq. yd., cash; or 28 cts., 61 and 18 cts. and $1.47, respectively, if bonds be taken in payment; Calnan Co., Clinton, 35 cts., 62 cts., 19 cts. and $1.45 cash, or 37 cts., 65 cts., 20 cts. and $1.51 bonds.

STONE.—Nashville, Tenn.—Capt. John Biddle, U. S. Engineer Office, has received the following bids for supplying stone for building locks 3 and 4 on the Cumberland River; Salem-Bedford Stone Co., Ind., sills, 186 cu. yds., at $14; hollow quoins, 196 cu. yds., at $17.42; coping, 640 cu. yds., at $14.65; pointed face, 4,000 cu. yds., at $12.54; rock face, 2,640 cu. yds., at $12.41; special stones, 250 cu. yds., at $18.87; total, $103,034; I. P. Shanks, Louisville, Ky., $21.10, $20.70, $18.90, $11.40, $11.10, $28.50, $102,106, respectively. Walter G. Kirkpatrick, Engr.

DAM.—Hanover, N. H.—We are informed by R. Fletcher, Engr., that the principal items of the contract noted last week as awarded to L. A. Taylor, Boston, at $15,400, were as follows: Grubbing, 4,140 sq. yds. surface, at 25 cts.; earth dam, 14,650 cu. yds., and 4,700 cu. yds. for core puddle and lighter slope, at 40 cts.; low core wall of masonry, in cement, 400 cu. yds., at $5; concrete masonry, 25 cu. yds., at $5.25; rubble masonry, in cement, 92 cu. yds., at $5.75; brick masonry, in cement, 30 cu. yds., at $12; dry rubble masonry, 125 cu. yds., at $3; paving inner slope, etc., 2,750 sq. yds., at $1. J. F. Springfield, Consult. Engr.

DREDGING.—Wilmington, Del.—Bids for the Assawoman Canal, between Chincoteague Bay, Va., and Delaware Bay, were opened by W. F. Smith, U. S. Engineer Office, July 18, as follows: Sanford & Brooks, Baltimore, 30 cts. per cu. yd., work to be completed within one year; B. G. Bailey, Philadelphia, 20.04 cts., work to be completed by Oct. 1, 1894; P. McManus, Philadelphia, 21 cts., work to be completed by Aug. 1, 1894; J. T. Brown, New York, 29¾ cts., work to be completed by Aug. 18, 1894.

SEWER PIPE.—Baltimore, Md.—The contract for terra-cotta pipe for a sewer in Union Ave. has been awarded to Harig Bros. at the following prices: 20-in., 53 cts. per lin. ft.; 24-in., 78 cts.; 30-in., $2.25.

MISCELLANEOUS.

BONDS.—Faribault, Minn.—Bids are asked until Aug. 5 for bonds for $31,000. Donald Grant, mayor.

GRADING.—Boston, Mass.—The park commissioners will receive bids until July 31 for grading at Wood Island Park.

SEA WALL.—San Francisco, Cal.—The board of engineers have ordered the construction of a sea wall estimated to cost $325,000.

COURT HOUSE.—Fort Worth, Tex.—The commissioners of Tarrant county will receive bids until Aug. 22 for a county court house.

YELLOW PINE TIMBER.—New York, N. Y.—The department of docks will receive bids until Aug. 3 for 1,597,585 ft. B. M. yellow pine timber.

NATURAL GAS FRANCHISE.—Schenectady, N. Y.—A franchise to furnish natural gas to the citizens has been granted to Geo. P. Waldorf and S. H. Kennedy.

NATURAL GAS WELL.—Redding, Cal.—About $1,500 has been subscribed and a partial organization formed to sink a well in Buckeye township to prospect for gas and oil.

BREAKWATER REPAIRS.—Milwaukee, Wis.—Maj. Jas. F. Gregory has estimated that it will cost $85,000 to repair the damage done to the breakwater by the storm last April.

PARK IMPROVEMENTS.—Harrisburg, Pa.—The East Harrisburg Electric St. Ry Co. has leased Paxtang Park, and will spend several thousand dollars in improving the grounds.

BOILERS, ETC.—Denver, Colo.—The board of capitol managers will receive bids until Aug. 20 for vault doors and vestibules, boilers, and for elevator pumps and pressure tanks.

BOILER HOUSE, ETC.—Boston, Mass.—Bids are asked until Aug. 4 for the erection of a boiler house and connecting corridors at Pierce Farm. Nathan Matthews, mayor; E. M. Wheelwright, Cy. Architect.

LOCK GATES.—Ottawa, Ont.—Bids are asked until Aug. 12 for the constructing and setting in place in working order of five pairs of lock gates at the Sault Ste. Marie Canal. J. H. Balderson, Secy. Dept. Rys. and Canals.

METAL WORK AND FOUNDATION PIER.—Baltimore, Md.—Bids will be received at the U. S. Engineer Office until Aug. 15 for the metal work and for the construction and sinking of the foundation pier for the Wolf Trap Light Station, Virginia. Capt. Eric Bergland, U. S. A.

REPAIRING DAM, ETC.—Albany, N. Y.—Bids are asked until Aug. 3 for repairing the dam across the Mohawk River at Cohoes; for constructing an arch culvert over the state ditch on Broad St., Tonawanda; and for filling and raising State dyke at Mull's Plaat. Edward Hannan, Supt. Pub. Wks.

INDUSTRIAL NOTES.

LOCOMOTIVES.—The Baldwin Locomotive Works, Philadelphia, Pa., are building 10 heavy freight engines for the New York & New England.

The Rogers Locomotive & Machine Works, Paterson, N. J., have completed 12 freight engines for the Wilkes-Barre & Eastern.

CARS.—The Ensign Mfg. Co., Huntington, W. Va., is building 100 stock cars for the Chesapeake & Ohio.

The Elliott Car Co., Godsden, Ala., has an order for 500 freight cars for the Louisville & Nashville.

Harlan & Hollingsworth, Wilmington, Del., have built seven passenger cars for the Pittsburg & Lake Erie.

The Wason Car Mfg. Co., Springfield, Mass., has built a dining car for the Delaware & Hudson; it is 62 ft. long, with 25-ft. saloon, seating 32 persons. The company has also built 35 passenger cars for the New York, Lake Erie & Western.

THE WESTINGHOUSE ELECTRIC & MFG. CO. has completed plans for its new works at Brinton, Pa., on the Pennsylvania R. R., about 11 miles from Pittsburg. About 23 acres will be covered by the new works. The machine shop will be 75 × 250 ft., the warehouse 750 × 250 ft., the foundry 700 × 250 ft., and the boiler house 150 × 40 ft. Including other buildings, the area of the ground floor will be 7⅜ acres, and including the second floors, 15 acres. The structures will be of steel and stone. Labor-saving devices will be employed to the fullest extent, and electricity will be employed as a motive power. A large number of homes for the use of the employes will also be erected. Work is expected to be commenced in September.

THE CRANE CO., of Chicago, has recently secured orders for its valves and hydrants for the following systems of new water works: Morton, Cicero, and Winnetka, Ill., and La Grange and Rochester, Ind. Its goods have also been adopted in the old works at Lacon, Ill., and Jackson, Mich. E. M. Nichols is the representative for this department.

CABLEWAYS.—The Court St. bridge, Rochester, N. Y., is being built with two Lidgerwood cableways, side by side. Lauer & Hagaman are the contractors.

TREASURY DEPARTMENT.—Office Supervising Architect, Washington, D. C., July 13, 1893.—Sealed proposals will be received at this office until 2 o'clock p. m. on the 9th day of August, 1893, and opened immediately thereafter, for all the labor and materials required for the excavation, concrete foundations, cut stone and brickwork, iron and wood floor, ceiling and roof construction, roof coverings, drainage, approaches, etc., for the U. S. Post Office building, at Staunton, Va., in accordance with the drawings and specification, copies of which may be had at this office or the office of the Superintendent at Staunton, Va. No convict labor nor the use of any product of convict labor will be allowed in the work. Each bid must be accompanied by a certified check for a sum not less than 2% of the amount of the proposal. The right is reserved to reject any or all bids or to waive any defect or informality in any bid, if it be deemed in the interest of the Government to do so. All bids received after the time stated will be returned to the bidders. Proposals must be inclosed in envelopes, sealed and marked "Proposal for the Excavation, Concrete Foundations, Cut Stone and Brickwork, Iron and Wood Floor, Ceiling and Roof Construction, Roof Covering, Drainage, Approaches, Etc., for the U. S. Post Office Building, at Staunton, Va.," and addressed to Jeremiah O'Rourke, Supervising Architect. 29-2t

---

Office of the Lighthouse Engineer,
Fifth District,
Baltimore, Md., July 24, 1893.

SEALED PROPOSALS will be received at this office until 2 o'clock p. m. of Tuesday, the 15th day of August, 1893, for furnishing materials and labor of all kinds necessary for the completion and delivery of the metal work for the foundation pier of Wolf Trap Light Station, Virginia.

Plans, specifications, forms of proposal and other information may be obtained on application to this office.

The right is reserved to reject any or all bids and to waive any defects.

ERIC BERGLAND,
Captain of Engineers U. S. Army, Lighthouse Engineer Fifth District. 30-2t

---

PROPOSALS FOR LAYING WATER PIPE.

Sealed proposals will be received until 2 p. m. on Monday, the 7th day of August, 1893, by the Board of Water Commissioners for the trench excavation laying of about 11,950 linear feet of 20-inch, cast iron force main and appurtenances. (Section No. 1.) Each proposal must be made upon the blank furnished by the board, and accompanied by a bond of $500 or an equivalent collateral security of the same amount; the bond or security to be returned unless forfeited by abandonment of the proposal.

The board reserves the right to reject any or all bids.

Plans can be seen and blank forms and specifications will be furnished on application at the water-works office.

Proposals must be properly indorsed and addressed to ALPHEUS GAY,
President Board of Water Commissioners.
GEO. E. EVANS, Engineer.
Manchester, N H., July 27, 1893. 30-2t

NOTICE TO CONTRACTORS.

PIEDMONT, W. VA., WATER-WORKS.

Sealed proposals will be received by the corporation of Piedmont, W. Va., until noon Aug. 20th, 1893, for furnishing all material and doing all labor necessary for the construction of a complete system of water-works for the town.

The work to be done includes the contruction of and supply of:

(1) A brick pumping station, including intake dam and suction well.
(2) Two "Duplex" pumping engines, capacity 750,000 gals. each.
(3) Two 70-HP. horizontal tubular boilers.
(4) Service reservoir, capacity 1,050,000 gallons, including gatehouse.
(5) 412 tons of cast iron pipes, 4 in., 6 in. and 10 in.
(6) 5 tons of special castings.
(7) 30 hydrants.
(8) 24 valves.
(9) The laying of 4½ miles of mains.

Bids will be received for the above work in whole or in part.

Plans and specifications can be seen and blank forms obtained at the Town Hall, Piedmont, W. Va., or at the office of the engineer, No. 137 Broadway, New York, on and after Aug. 3d, 1893.

The Town Council reserve the right to reject any or all bids and accept any that may, in their judgment, be for the best interest of the town.

Certified check for $250 must accompany each bid.

Bids must be addressed to J. H. Bell, Recorder, Piedmont, W. Va.

J. W. W. DAVIS, Mayor.
J. H. BELL, Recorder.
ALEXANDER POTTER, Designing Engineer. 30-4t